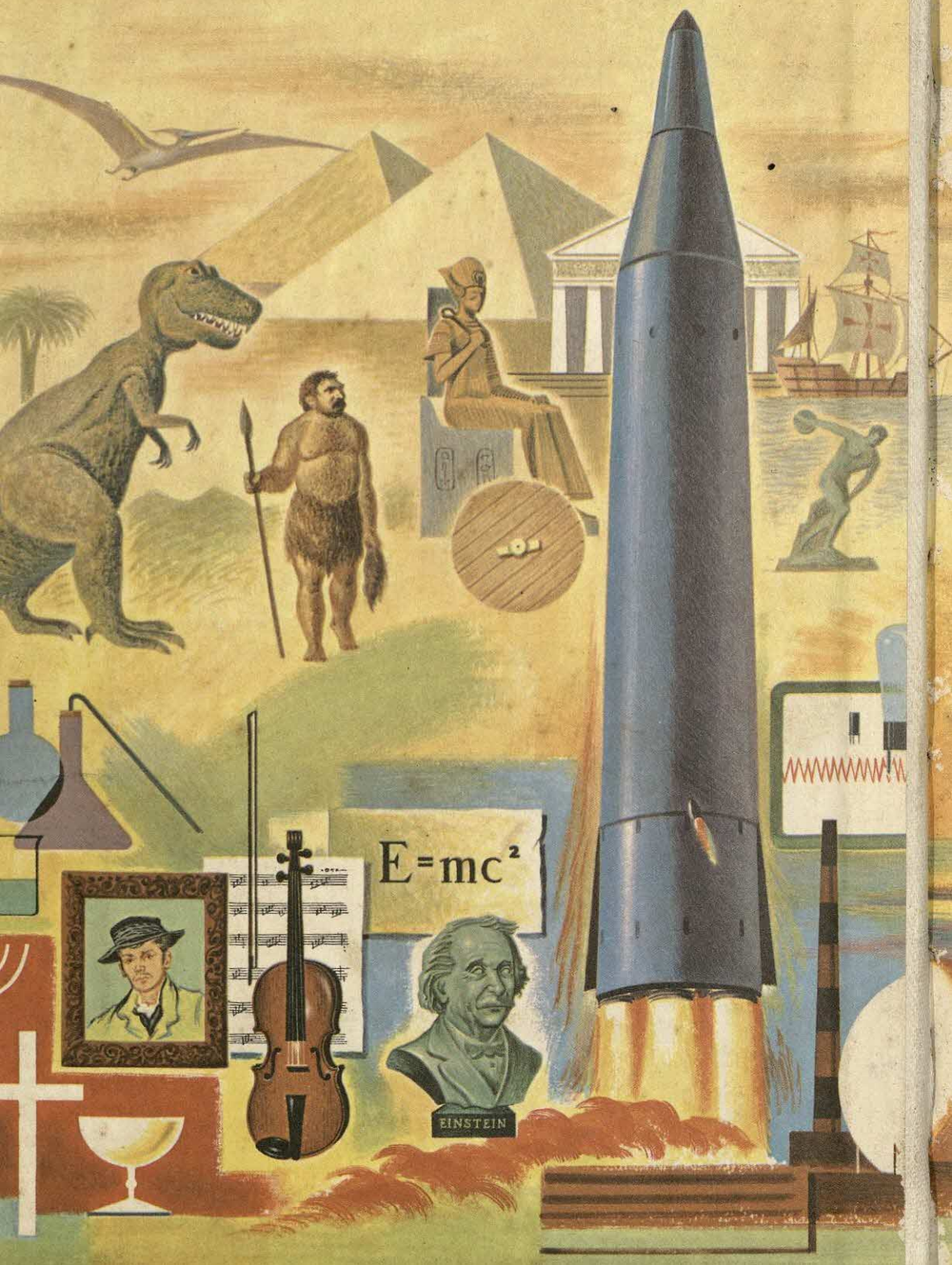


THE WONDERLAND OF KNOWLEDGE





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THE WONDERLAND OF KNOWLEDGE

The Pictorial Encyclopedia



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PRONUNCIATION

The pronunciation of titles is indicated by accenting the word or by respelling it phonetically in italics. In the phonetic spelling, letters are used to indicate the sounds which they most commonly represent.

A vowel is *short* when followed by a consonant in the same syllable, unless the syllable ends in silent *e*.

A vowel is *long* when the letter occurs in a syllable which ends in silent *e* or when ending an accented syllable.

The hard sound of *c* is represented by *k*.

The hard sound of *s* is represented by *z*.

The foreign sounds which have no equivalent in the English language are represented as follows:

N for the French *n*, as in Breton: (**Breton**, *bre toN'*).

ö for the German *ö*, as in Göttingen: (**Göttingen**, *gö' ting en*).

ü for the German *ü*, as in Blücher: (**Blücher**, *blük'ur*).

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for whom this book is made



They are all here—the heroes and the rogues, the brave and brilliant women, the soldiers, scientists, and saints whose stories will give you lifelong delight.

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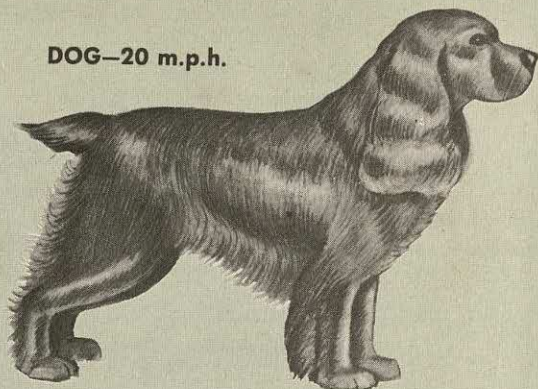
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ELEPHANT—24.5 m.p.h.

DOG—20 m.p.h.



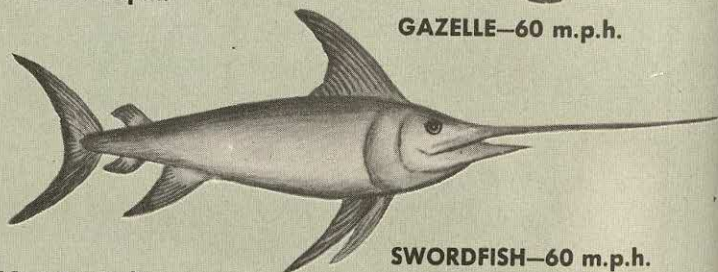
TORTOISE—.25 m.p.h.



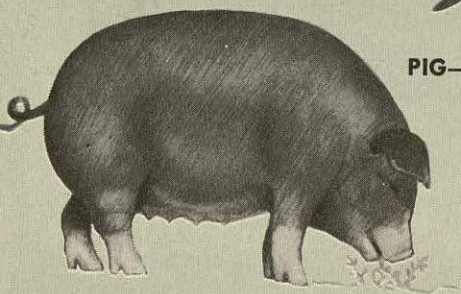
RACEHORSE—40-42 m.p.h.



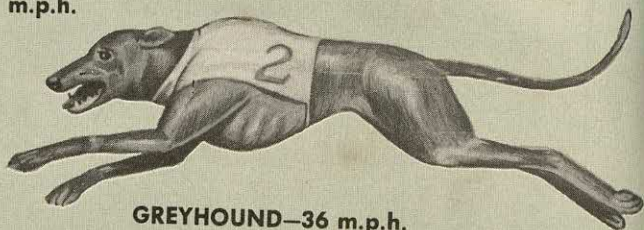
GAZELLE—60 m.p.h.



SWORDFISH—60 m.p.h.



PIG—11 m.p.h.



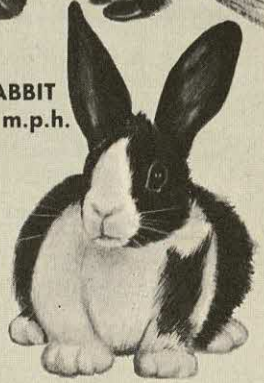
GREYHOUND—36 m.p.h.

A Wonderland
PICTURE STORY
Volume I

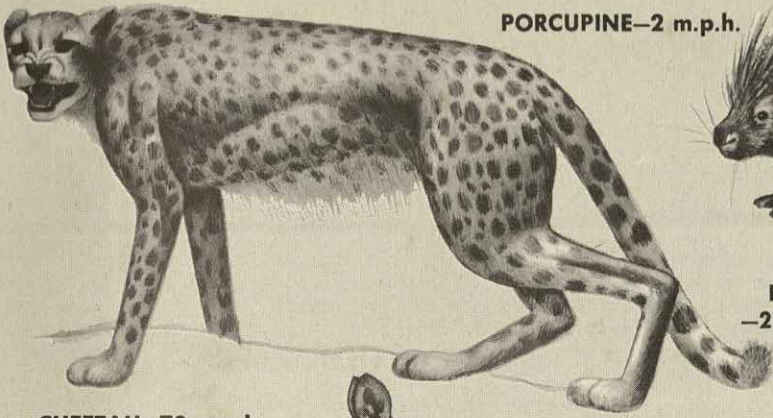
PORCUPINE—2 m.p.h.



**RABBIT
—25 m.p.h.**



CHEETAH—70 m.p.h.



EMU—31 m.p.h.



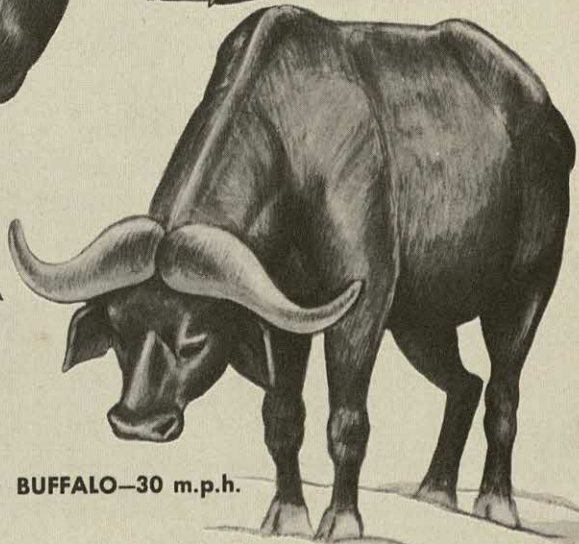
KANGAROO—30 m.p.h.



DEER—30 m.p.h.



BUFFALO—30 m.p.h.




GOLDEN EAGLE—120 m.p.h.



ANIMAL. On land, in the air, and in the water, the various members of the animal kingdom show an interesting range in their rates of speed. Compare, for instance, the speed of the rabbit with that of the plodding tortoise. See page 128.

Did you ever want to know—



About the CONQUEST of the AIR

Who made the first non-stop flight across the Atlantic Ocean?

On June 14 and 15, 1919, Captain John Alcock and Lieutenant Arthur W. Brown, British aviators, flew from Saint Johns, Newfoundland, to Clifden, Ireland. See AIRPLANE; FLYING, STORY OF.

How does an airplane pilot make a "blind" landing?

As the pilot approaches the airport, his radio receiver picks up "beams" sent out from a transmitter on the ground. By following these and his instruments, he is able to make a landing without seeing the ground. AIRPLANE; RADIO.



About the TREASURES of the SOIL

Where does aluminum come from?

Aluminum is found in all soils, but it is usually made from bauxite, which occurs in clay beds. The clay is cooked, treated, dissolved, and electrified to obtain the pure aluminum. See ALUMINUM; BAUXITE.

Who were the first scientific farmers?

The ancient Greeks and Romans are known as the first scientific farmers because they were the first to practice crop rotation. The Romans, particularly, learned to sow a field with soil-building crops, and allow it to stand idle for a season. This procedure is still followed today. See AGRICULTURE.



How SCIENCE works for YOU

Why does silver polish make a spoon shine?

The tiny flakes of the polish, though appearing soft and smooth, are really harder than silver. When rubbed on the silver, their millions of knife-like edges wear away the tarnish and smooth the scratches. See ABRASIVES.


What causes typhoid fever?

Through the study of minute living things called bacteria, we have been able to learn the causes of typhoid fever and many other diseases. See BACTERIA AND BACTERIOLOGY.

How does a blowtorch cut metal?

In cutting steel, a blowtorch heats the metal by a

flame from acetylene gas, then "eats" through it with pure oxygen. This process of "oxidizing" is what makes the blowtorch capable of cutting through the hardest of metals. See ACETYLENE.



About the LURE of HORIZON LANDS

Where is the largest coral formation in the world?


Great Barrier Reef, which skirts the northeastern coast of Australia for a distance of 1,250 miles, is the largest of coral formations. It creates an inner passage for ships in the coastwise trade. See AUSTRALIA; also BARRIER REEF, GREAT.

What continent is still in the grip of the Ice Age?

The Antarctic continent is covered by a huge ice sheet, preventing any human beings from living there permanently. See ANTARCTICA.

Where are the highest and lowest places in the United States?

The highest and lowest points of the United States and also of North America are: Mount McKinley, Alaska, 20,320 feet high, and a part of Death Valley in California, 282 feet below sea level. See ALASKA; CALIFORNIA.



About our SPORTS and GAMES

Why has baseball become the American national pastime?

During the Civil War, armies on both sides played baseball in their camps. When the war ended, the returning soldiers introduced the game at home, and teams were formed in almost every city and village. Baseball was played in so many different communities it was soon the most popular American sport. See BASEBALL.

What is the difference between an amateur and a professional athlete?

An amateur is one who takes part in a sport for pleasure, while a professional is paid for playing, coaching, etc. See ATHLETICS.



About MEN who made HISTORY

Why was King Alfred called Alfred the Great?
Not only was Alfred a brave warrior, but he was also a brilliant scholar and lawmaker. He restored learning in England; enforced wise and just laws, and gave the world priceless literature. See ALFRED THE GREAT.

What President of the United States was the son of a former President?

John Quincy Adams, who held the highest office in the United States from 1825 to 1829, was the son of John Adams, the second President, who served from 1797 to 1801. See ADAMS, JOHN QUINCY; ADAMS, JOHN.

Who was the teacher to whom Alexander the Great owed his love of learning?

Inspired by Aristotle, the wisest man of the age, Alexander learned to revere Greek culture, and he conquered an empire in order to establish Greek civilization in the Eastern world. See ARISTOTLE; ALEXANDER THE GREAT.

About the OTHER WORLDS

What is the "evening star"?

The "evening star" is really a planet. It usually appears soon after sunset, and when it is very bright, may be VENUS, JUPITER, MARS, SATURN, or MERCURY. See articles under these titles or ASTRONOMY.

Is there only one stellar universe?

There are probably millions of universes containing planets, stars, suns, and meteors like our own stellar system. The nearest of these "island universes" is 800,000 light years away. See ASTRONOMY.

About the ART of WAR

What were the most powerful hand weapons known to man before the use of gunpowder?

The English longbow, made of the wood from the yew tree, and the crossbow, of steel, could shoot arrows, or bolts through thick metal armor. The longbow established English supremacy as early as the Battle of Crécy, in the year 1346. See BOW; ARMOR.

Why is the infantry important in war?

The foot soldier can move from place to place; under his own power he can attack and can defend. The infantry also is the only unit of the army that can hold a position once it has been gained. See ARMY.

About CREATORS of BEAUTY

What composers are known as the three "B's"?

Bach, Beethoven, and Brahms are recognized as the three outstanding masters of instrumental music. All were of German birth. See articles under their respective names.

What French painter of animals was a woman?

Rosa Bonheur is one of the few women to attain high rank as an artist. Her most famous painting, *The Horse Fair*, is in the Metropolitan Museum of Art, New York. See BONHEUR, ROSA.

About the MARVELS of MODERN MACHINERY

How does the automobile help civilization?

It brings people closer together, enables them to travel freely, opens up new regions that have no railroads, and provides a vast number of people with employment. See AUTOMOBILE.

Why is a heavy, fast train able to stop quickly?

Because of the air brake. This device uses compressed air to stop the wheels, and so effective is it that a mile-a-minute train can stop in its own length. See AIR BRAKE.

About MAN and NATURE

Why do some men have dark skins, and others light?

Thousands of years ago, before man conquered the conditions surrounding him, climate completely governed his life. In climates where the sun was hot, for instance, dark-skinned races developed. The classification of the different races is usually based on the color and form of hair, color of skin, stature, shape of head, and other distinctive characteristics, and is a branch of anthropology. See ANTHROPOLOGY.

What creature besides man keeps a dairy?

Among the many fascinating habits of the ant is that of "milking" aphids, or plant lice, to obtain a sweet, milky liquid. The lice are tended by the ants and herded on leaves so that they may gorge themselves with the delectable substances. See ANT; APHIDS.

*These questions are just a few of the thousands
answered in this and other volumes*


From
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


AN EDUCATIONAL CENTER
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A. Who would guess that our familiar letter *A* started in life upside down? All the letters in our alphabet have family trees reaching back to the beginning of writing, and our first letter has one of the most interesting stories.

The Phoenicians were the great travelers and traders of their time, and they needed a written alphabet for their business records. From the cultured people around the Mediterranean, the Egyptians, the Babylonians, or the Cretans, they borrowed the sign for *A*, but they wrote or carved it like this, , upside down. It stood for "ox" or "ox's head." This was about 1300-1000 B.C.

When the Greeks took over this sign, they gradually turned it around until it looked more like our letter of today; ; and so it passed into Latin and on down to modern alphabets.

AARDVARK, *ahrd' vahrk*. What an odd-looking creature this is! It has an odd name, too. *Aardvark* is a Dutch term meaning *earth pig*, and the animal was given this name by the Dutch people of South Africa, where it is found. Because it feeds on ants, the aardvark is also called anteater.

This animal is stout and somewhat bent in the middle, so that its long, piglike snout seems to be almost on the ground. Its two very large ears look entirely out of place, and its tail is rather long for its body. The front feet of the anteater are provided with four powerful claws, the hind feet with five. These claws make it easy for it to burrow quickly under the ground.



THE AARDVARK

The anteater has an easy time getting its food, for it has a long, flexible tongue covered with sticky saliva. At night it finds a hill of white ants which it destroys with its strong claws. The ants have little chance to escape from the long, sticky tongue that works so rapidly.

Although the anteater looks rather fierce, it is really a very timid animal. When pursued it will burrow its way underground with such speed that it is almost impossible to dig it out. The burrow or hole that it digs in the ground is its home.

It spends its days there and goes out only at night. The anteater is hunted and killed by the South African natives, for they consider the meat quite a delicacy.

ABBEY. In the latter part of the third century, a holy Christian man, named Anthony, wished to escape from the wickedness of the cities, in order to devote his life to prayer. So he went out into the desert and built himself a small hut. There he lived alone, with very little to eat and only his poor hut for shelter. Soon other men began to follow the example of Anthony. Many of them went into the desert and built huts near his. These hermits, as they were called, would meet together every day for prayers and religious services.

Finally they decided to select the holiest man from their ranks and make him their leader. He was called by the Syrian word, *abba*, which means *father*. This was the beginning of the movement that led to the founding of the famous abbeys, or religious communities.

John Cassian (360-435) was one of the first men to start an abbey. At Marseilles, he founded Saint Victor's, a community for monks. In the sixth century, Saint Benedict founded the famous abbey of Monte Cassino, the first of the great Benedictine abbeys in Western Europe; these were planned by Saint Benedict so that each abbey should contain everything necessary for life and that the monastery should be the monks' homes. Monte Cassino was bombed in World War II.

In a typical abbey the central building was the large church built in the shape of a cross. Around the church all the other buildings would be grouped. The cloister garth was an enclosed space surrounded by a colonnaded walk called the cloister. Along this walk the monks would spend their time walking, praying, talking, or meditating. Sometimes the older monks would sit here copying manuscripts or teaching the younger monks. The other buildings included a dormitory for sleeping, a common dining hall, a guest house, an infirmary to care for the sick, and an almonry where people left alms for the monks.

In the abbey all the monks did some

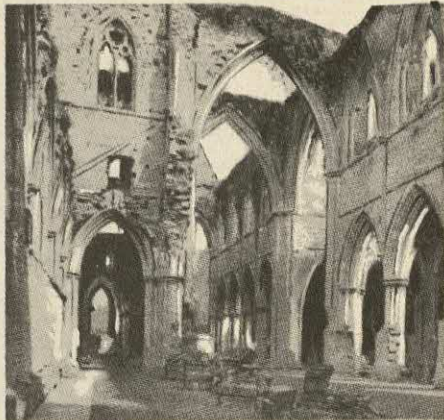
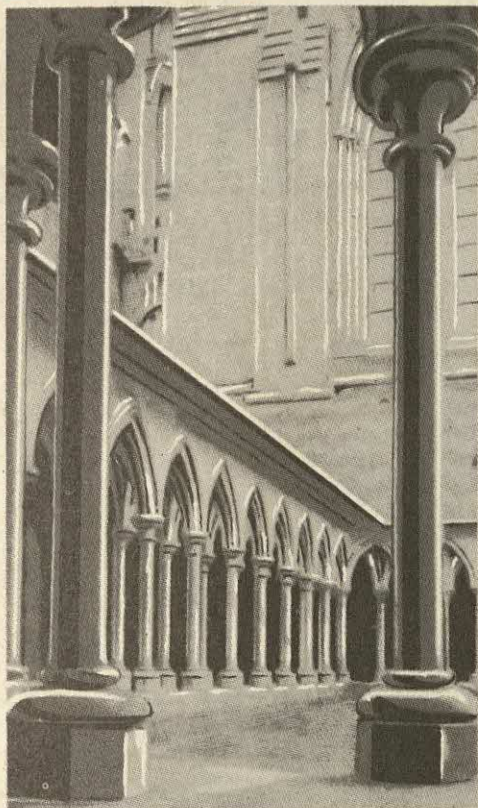
kind of work. The fields had to be plowed. Crops had to be planted and harvested, and the horses, sheep, and cattle required much care. Besides doing all these things, the monks spent much of their time teaching the people and taking care of the poor, sick, and needy. The abbeys were the treasure houses of knowledge. In them were to be found many books which the monks had painstakingly copied by hand. The diaries kept by these monks give us a record of their times.

At the head of each abbey was an abbot whose power was very great. As the abbeys grew larger, little villages would grow up about them. The abbot was usually the landlord of all the surrounding territory. Sometimes the tenant would become dissatisfied and it would be necessary to draw up papers stating the rights of the tenant and the landlord. This business kept many of the monks occupied with legal matters. The abbeys continued, in many cases, to grow larger and wealthier, and as time passed on, the monks became less interested in leading simple, austere lives. In many abbeys the rigid discipline was relaxed.

This state of affairs led to the formation, in the thirteenth century, of the orders of friars. They worked among the poor and sick and allowed themselves no worldly possessions. These simple friars and the reformed orders, such as the Cluny, Cistercian, and Carthusian, did much to preserve a respect for learning and piety during the Dark Ages.

As the abbots grew in power and wealth, they came to be rated next to the bishops as prelates of the Church, and were influential in Church councils. Communities of nuns, called convents, were ruled by abbesses. These compared, in rank and authority, with the heads of monasteries, or abbeys for monks. Famous abbeys in Europe include Cluny and Clairvaux in France, Saint Gall in Switzerland, Fulda in Germany, and Tintern and Paisley in England and Scotland.

A BECKET, THOMAS. See BECKET, THOMAS A.

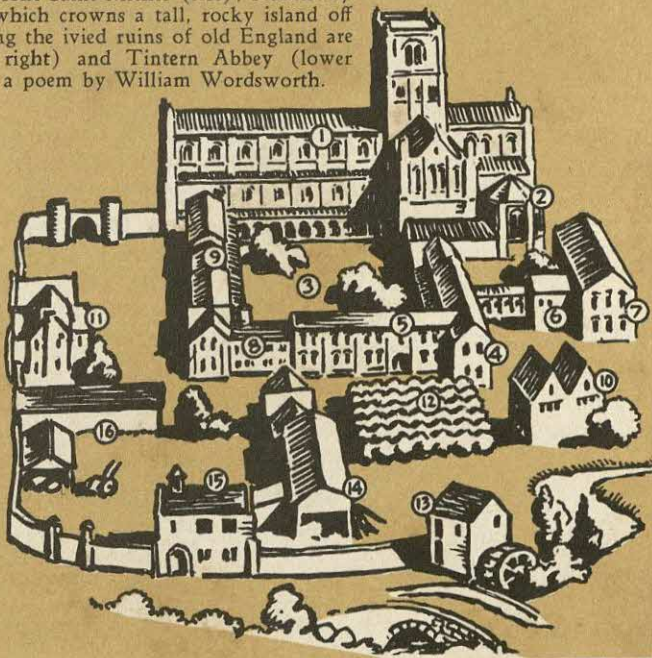


FAMOUS ABBEYS OF EUROPE

A view of the cloister of Mont Saint Michel (left), beautifully preserved medieval abbey which crowns a tall, rocky island off the coast of France. Among the ivied ruins of old England are Fountains Abbey (upper right) and Tintern Abbey (lower right), made famous in a poem by William Wordsworth.

THE LARGE ABBEY WAS A COMPLETE COMMUNITY

The typical arrangement is shown at the right. (1) Church, center of community. (2) Chapter House. (3) Cloister Garth or enclosure. (4) Dormitory. (5) Refectory or dining hall. (6) Misericorde. (7) Infirmary. (8) Kitchen. (9) Cellar. (10) Abbot's House. (11) Guest House. (12) Orchard. (13) Mill. (14) Barn. (15) Almonry. (16) Stable.





EDUCATION IN THE TWELFTH CENTURY

Appreciative students of Abelard erected the Paraclete, a building in which they could meet and hear his lectures.

ABELARD, *ab'e lard*. So wide was the renown of Pierre Abelard (1079-1142) that even as a young man he attracted to himself the ablest scholars of the day. From Rome, England, and Germany they came to Paris to hear his eloquent lectures. This brilliant thinker and student of religion was at the height of his popularity when he secretly married the beautiful Heloise, niece of Fulbert, canon of Notre Dame.

Then sorrow came into his life, for the vengeful canon put an end to the marriage. A religious council later condemned Abelard's teachings as contrary to Church doctrines, and in 1142 the Pope declared him a heretic. He was doomed to perpetual silence, and he died within a few months.

Heloise lived a long and useful life as

a nun, and when she died she was buried beside her lover. Their tomb in the cemetery of Père-Lachaise is still a point of interest in Paris.

ABERDEEN, SCOTLAND. Where the river Dee comes down to the North Sea, near the mouth of the Don, stands the "Granite City" of Scotland—Aberdeen.

Building slowly and solidly from its twelfth-century beginnings, Aberdeen has become the fourth city of the country, the educational and commercial center of the North. Here is the University of Aberdeen, formed in 1860 by the union of two old colleges: King's, which was founded in 1494, and Marischal, dating from 1593. Students from the immediate region and beyond are attracted to the university library, where they may consult more than 140,000 volumes, largely devoted to Celtic

literature. Other seats of learning in the town are Robert Gordon's College, an art school, and the Mechanics' Institute.

As 'becomes a city which produces great quantities of polished granite, Aberdeen has many impressive structures, built of the finest stone afforded by the local quarries. The principal university buildings, the Trades' Hall, the Cathedral of Saint Machar, and the Music Hall buildings are among the architectural landmarks. These, fitting into the regular plan of the city, and many broad, well-paved avenues make Aberdeen one of the handsomest cities in the British Isles.

With its excellent harbor, it is a port of call for steamers from London, Hull, and other coastal points. A large fleet of trawlers also has its base here and contributes to the importance of water-borne commerce. Fish for inland Scots and Englishmen is a principal item of export. The chief local industries besides fishing and quarrying are shipbuilding, distilling and brewing, and the manufacture of chemicals, coal, textiles, and paper. Population is about 330,000.

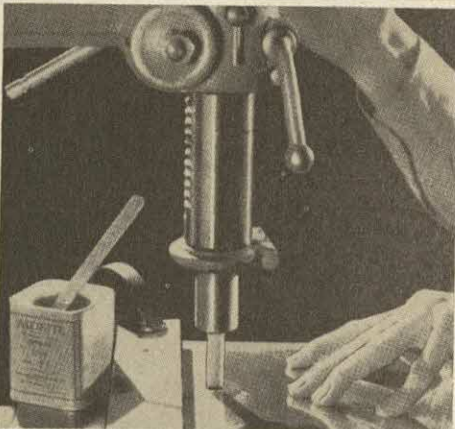
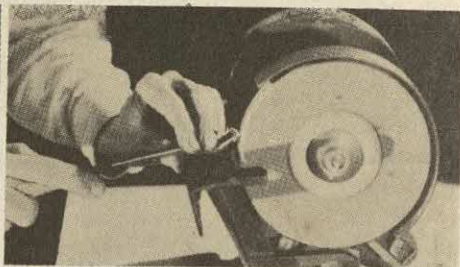
A'BRAMHAM. In the early days of the world, according to the Bible, God called upon a rich and good man named Abram to leave his home in Mesopotamia and go to a new land. There, God told him, he was to become the father of a chosen people. His name, which meant *exalted fa-*



ABRAHAM AND HAGAR

ther, was changed to Abraham, meaning *father of many*. The "chosen people" became known as the Hebrews, and today the descendants of Abraham live throughout the world, and honor him as the father of their race.

Abraham was born in Ur of the Chaldees in Mesopotamia, but later lived in Canaan, where the Hebrew race was founded. Abraham had two sons. One of them, Isaac, became a patriarch of the Hebrews, while Ishmael, the other, was one of the forerunners of the Arabs. Abraham is said to have lived 175 years, and when he died, he was buried in a cave with his wife, Sarah. See BIBLE, subhead *Bible Stories*.



ABRASIVES ON THE JOB *Courtesy of the Carborundum Co.*

The speed and quality of production are increased in modern industry by special abrasives designed for every polishing and grinding job.

ABRASIVES, *ab ra'sivz*. When you polish your silverware with "silver polish," you do exactly the same thing that savages did to make their stone hatchets. You wear down one kind of substance with another that is harder. Silver polish is smooth and soft, you think. But just rub a bit of it between your fingers and you will notice that it is full of ever-so-fine gritty or sandy particles. These tiny flakes are harder than silver. When rubbed over silver, their millions of little knifelike edges wear away the tarnish and smooth out the scratches, leaving your knives and forks bright and new looking.

Materials used to grind or polish are called abrasives. When did abrasives first come into our lives? No one knows. Cavemen made stone tools by rubbing them with harder, rougher stones. For generations farmers have used sandy-surfaced "whetstones" to sharpen their scythes, and the grindstone wheel, turned

with a foot pedal, is still to be seen on almost any farm.

But it is in the big factories that abrasives really mean so much in our lives. Take automobiles, for example! If scientists had not discovered hundreds of different kinds of grinding materials and many kinds of machines with which to grind and polish, automobiles would cost so much that only the very rich could afford them.

How are grinding and polishing done in factories today? The most common tool is the high-speed wheel. If you have ever stood and watched a man sharpen your ice skates, you have seen such a wheel, throwing bright sparks as it grinds. The abrasive particles may be held together by various solid substances. It is told that an early inventor made one of the first modern grinding wheels by spreading a mixture of shellac and emery dust on top of his mother's stove, prying up and trim-

ming the mass round after it was baked hard.

Grinding wheels sometimes turn 20,000 revolutions a minute, and their rims travel as fast as a streamlined train. Besides wheels, factories also use endless pulley belts coated with abrasives. Visit any woodworking shop or manual-training room at school and you can see such belts, made from sandpaper.

Flat discs coated with an abrasive are used to polish wood floors and many flat objects of glass or metal.

Then, too, abrasives are often used in powder form, mixed with water or oil to lubricate and cool the surface being ground; for rubbing produces heat. One of the most interesting examples of loose-powder grinding is in the making of glass lenses. When big telescope lenses are being polished, the scientists must avoid making even the tiniest scratch. So they use rouge, very much like the cosmetic used for beautifying a face. Rouge particles are made of a soft natural stone called pumice, and though ground so fine you have to have a microscope to see them, they slowly wear a shiny and amazingly perfect lens surface.

Nature has provided many ideal abrasives. These include such minerals as emery, corundum, quartz (ordinary sand), flint, glass, garnet, sandstone, pumice, diatomaceous earth, and diamond. The last two are particularly interesting. Diatomaceous earth, used in many industries, is an earth material made from the remains of diatoms, or plants that lived and died millions of years ago.

Diamond is a fine abrasive because it is the hardest substance in the world. For that reason, tiny diamonds are set in the teeth of oil-well drill bits and other tools that must cut through very hard rock. In one large automobile plant, so many thousands of dollars' worth of diamonds are used in grinding tools that one man is employed to do nothing else but look after them. Only diamond will cut diamond, and stones not clear and perfect enough

to make into gems are made into fine diamond dust, and used to grind and polish their more elegant brothers.

Scientists have discovered how to make some very important and very hard abrasives. One, called aluminum oxide, is made in an electric furnace at over 4,000 degrees Fahrenheit, one of the hottest temperatures ever created by man. Another is carbide of silicon, which is made also in an electric furnace, from a combination of coke, salt, sand, and sawdust.

For some of the common abrasives, see CARBORUNDUM; EMERY.

ABSORPTION. If your blood did not absorb oxygen from your lungs and carry it to the different parts of your body, you would die. A fish would die if you put it in water that had absorbed no air. If the roots of plants were not able to absorb water from the ground they would die. Since absorption is so important, it is well to understand what it is.

The word comes from the Latin and means *to suck in*, and this phrase exactly describes what absorption is. Two common examples of absorbing bodies which everyone has seen are the sponge that takes up water, and table salt which cakes by drawing water vapor from the air. Absorption, then, is the mixing of two substances, but in this mixing, one substance retains its original shape and form while the other seems to disappear.

Solids often take in liquids. Liquids usually absorb gases. Although the absorbed substance disappears, it has an effect upon the substance which absorbs it. Soda water has a very different taste from ordinary water, due to the carbon-dioxide gas it has absorbed.

Absorption is important in the human body, for it is by this process that the lining of the small intestine takes up digested food, while the blood takes up oxygen from the lungs to burn that food and turn it into energy. Other organs absorb waste products and carry them from the body to keep the human mechanism in good running order.



THE TRAGEDY OF ACADIA

The Acadians lived in the lands shown in the large circle. Exile by the British destroyed their way of life.

ABYSSINIA, *ab i sin' i a*. During the Italian conquest of Ethiopia, some people were puzzled, perhaps, by frequent newspaper references to Abyssinia. This is the name by which Ethiopia was known for more than twelve centuries. In ancient history, a part of Abyssinia was included in the very ancient country of Ethiopia, and the latter name might have continued for all time had it not been for the Arab invasion of North Africa in the seventh century. The Arabs called this part of their conquered territory Abyssinia, and the name after that was official for more than a thousand years.

In 1923 the people, proud of their race and disliking the word Abyssinia, which means *mixture*, decided to restore to their land its ancient name. The term Abyssinia was officially dropped, although the country was popularly called by the old name almost to the time of the Italian invasion. See **ETHIOPIA**.

ACACIA, *a ka' sha*. Medicine, snuff, furniture, tannin, mucilage, paste — all these things are made from the bark, fruit, or wood of the acacias. These shrubs and trees are native to tropical and sub-tropical regions, especially in Australia and Africa. There are more than 500 species of trees and shrubs belonging to this group of plants. In the United States, acacias are grown in California and near the Gulf of Mexico.

The fruit of the acacia is a dry, unjointed pod. In one variety the seeds from the pod are roasted and used as snuff. Several African acacias yield gum arabic, which is used to thicken ink and to make mucilage and paste. Others are cultivated for perfume or for the fragrant wood valued by Oriental peoples for altars, coffins, etc. An Indian species yields the valuable medicine, catechu, which is used in certain intestinal disorders and in hemorrhage.

The bark of the wattle tree, an acacia that grows in Australia, contains a large percentage of tannin, which is used for tanning leathers and making inks, as a mordant to fix dye colors, and for other industrial processes.

The common locust tree of the North Temperate Zone resembles the acacia so closely that it is often called *false acacia*. This pretty plant has feather-like leaves and, early in the summer, clusters of bright blossoms. See **LOCUST**.

ACADEMY, *ak ad e mi*. In the quiet shade of a grove north of Athens, Plato was accustomed to talk with a group of young men. At forty, full of wisdom both worldly and spiritual, this philosopher of ancient Greece could lead his followers to the very heights of reasoning. They shared his brilliant thinking eagerly. How fortunate they were, as they grew older, to be able to introduce their sons into this company of scholars! For Plato continued his personal leadership for forty fruitful years.

The meeting place had been named for Academus, one of the heroes of the Tro-



THE FIRST ACADEMY

Plato, the Greek philosopher, talks to his students.

jan War. The name became especially associated with Plato's gathering of students, which was eventually referred to as the Academy. From this grew the modern meaning, which includes any body of men banded together in scholarly, scientific, or artistic effort.

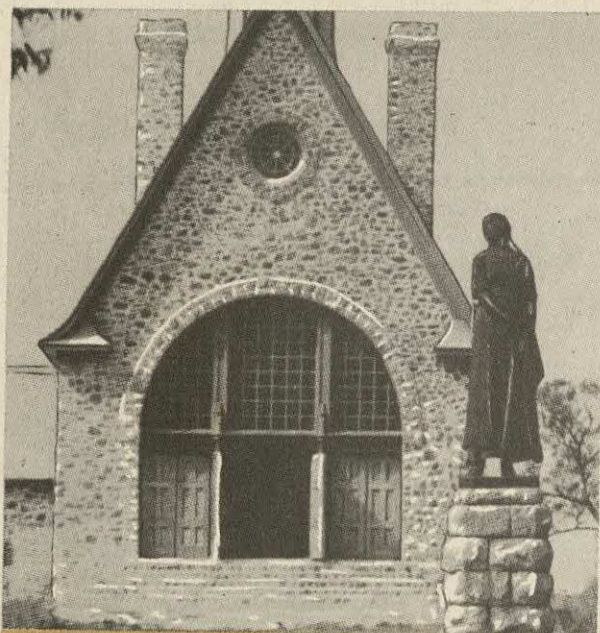
When Cardinal Richelieu selected forty distinguished men to set the highest standards for French literature, he founded the French Academy. This institution, which dates from 1635, is the most notable of all academies, and has played an important part in the cultural life of France for over 300 years. To be elected a member of this select forty is to become one of the "immortals" of France. Today, men who have distinguished themselves in many fields of endeavor sit in the chairs of Victor Hugo, of Anatole France, and of Pasteur.

Similar academies influence the sciences and arts in other countries, such as the Royal Academy of British Artists and the American Academy of Arts and Letters. The first American academy was the American Philosophical Society, organized in Philadelphia, in 1743. In current Amer-

ican usage, the term academy generally means a college-preparatory or specialized school. Phillips Exeter Academy at Exeter, N. H., and the United States Military Academy at West Point are well-known examples of the many American schools of this type.

ACADIA, a *ka'di a*. In the forests and on the coasts of Nova Scotia live a small group of people who speak French, who still fish and hunt as they did many years ago, and who observe customs strange to the other people dwelling on this eastern peninsula of Canada. These people are the descendants of the Acadians who once lived in the region that included what are now the Canadian provinces of Nova Scotia, New Brunswick, Prince Edward Island, and parts of Quebec and the state of Maine.

The story of Acadia and the Acadians is a tragic and obscure one, and had it not been for the great American poet, Henry Wadsworth Longfellow, it would have remained almost unknown. Yet, even though the immortal and beautiful poem *Evangeline* is familiar to thousands of people, there are many facts about these hardy and peaceful Acadians that have remained hidden.



THE EVANGELINE MONUMENT, GRAND PRÉ,
NOVA SCOTIA

Longfellow's heroine is honored in the land of the peaceful
Acadians.

We know that in 1605, a French merchant named De Monts sailed with a group of Huguenots and Catholics to Acadia to found a colony for the French fur trade. It is recorded that De Monts named two harbors: Port Rossignol, after the captain of a ship which he captured, and Port Mouton, for a sheep that fell overboard.

The Acadians, as they called themselves, prospered in the new country, for the "forest primeval," as Longfellow described the land, abounded in game, and the many lakes and rivers were filled with fish. But the English claimed the land because of the voyages of the Cabots many years before, and, in the years following the founding of the colony, there were several struggles for the territory between the French and the English. Finally, in 1713, France was forced to cede Acadia to England, but the little band of Acadians remained French.

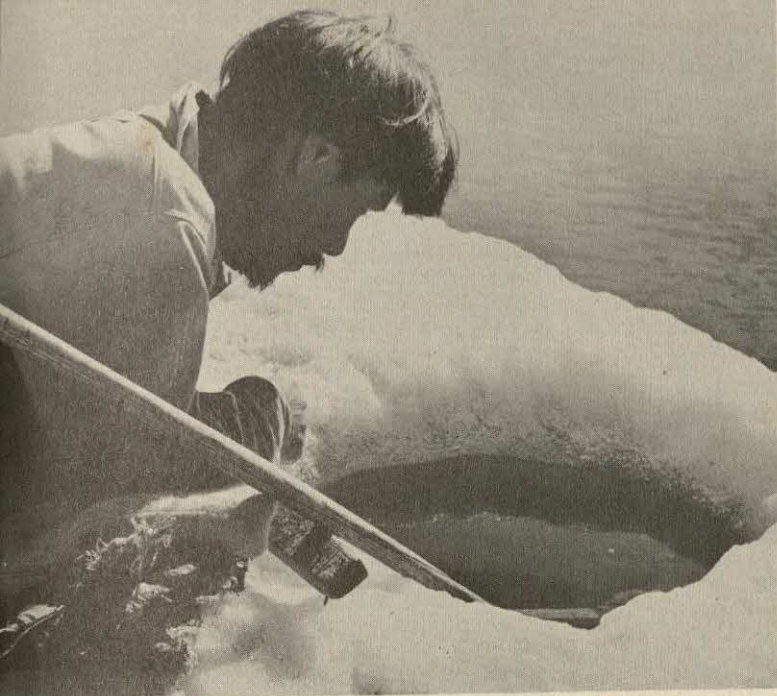
The English founded their first colony at Halifax after this, and settlers began to come to the country. They disliked the

Acadians because the number of French colonists was growing and the English were afraid they would be crowded off their land. The British then commanded the Acadians to swear allegiance to England, but the stubborn Frenchmen refused.

Finally, on Sept. 5, 1755, after a meeting in the church of Grand Pré, the English commander John Winslow seized the Acadians and expelled them from the land. A few escaped into the forests, but their farms and towns were destroyed, and their crops were seized. More than 6,000 were sent away from Acadia in ships. They were scattered throughout the American colonies where they had no homes, where they were treated as outcasts, and where they were separated from their families and from people they loved.

It was this cruel incident that inspired Longfellow to write *Evangeline*. This poem tells how Gabriel was taken from his sweetheart Evangeline, and how Evangeline searched for him throughout the American colonies, never losing faith that she would find him. Finally, on his deathbed in Pennsylvania, after years of wandering, they were united.

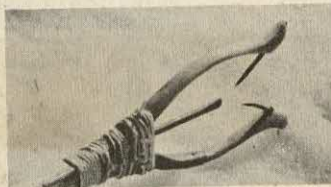
As the sad story relates, the Acadians were brought to all parts of the colonies, where they became outcasts and wanderers. Three shiploads of the unfortunate French settlers were taken to Pennsylvania; another group was taken to Massachusetts; still others were brought into the South, principally Louisiana. In no place, however, were they welcomed, except by the Quakers. Later, about 800 Acadians returned to their native land, where they joined the few who had escaped being taken from their homes. It is their descendants who compose the group of quaint French settlers in Nova Scotia today. See *EVANGELINE*.



Richard Harrington; Unations

DIFFERENT CLIMATES—DIFFERENT LIVES

An Eskimo of northern Canada (above), fishes through an air hole with a spiked spear (right). Below, Arabs, camel, and donkey thrive in desert heat.



ACCLIMATIZATION, *ak kly ma ti-zá'shun*, or **ACCLIMATION**, *ak kly ma'shun*. From burning tropical lands to cold Polar regions, in deep valleys and on high mountain peaks, living things can be found. They are alive because nature gave them ability to adapt themselves to extremes in temperature and altitude. The man who moves from his home in the cool north to live in the far south in time becomes accustomed to the warm climate.

The process of making these adjustments is called acclimatization. Men, beasts, and certain plants can acclimate themselves.

Animals differ greatly in their ability to adapt themselves to different climates. Man is the most adaptable, but the dog, cat, and mouse have followed him into all parts of the world and seem also to thrive wherever they go. As a general rule, most animals can adapt themselves if the new conditions of climate are presented slowly. For example, if a polar bear were suddenly transported from his home in the north to a place in the central or southern part of the United States, he would probably die. If, however, the change were made gradually, he would be able to adapt himself to his new home.

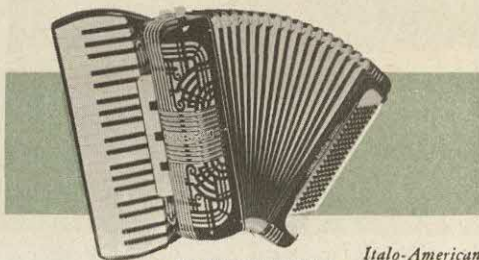
Examples of animals which have become acclimated may be seen in any large zoo. One very common example of complete acclimatization is the canary. This little bird was originally imported from the Canary Islands, off the northwest coast of Africa. Although he was put in a cage and reared in different climates, he remained cheerful and healthy.

In the plant world, adaptation is more difficult and does not occur as often as in the animal kingdom. Corn, for instance, cannot be grown successfully in the short, cool seasons of the northern temperate regions, and wheat does not thrive in regions of extreme heat or cold. In some cases, plants may grow well for a time in a new climate, but later fail to develop fruit or stop short of the growth which they would attain in their natural home.

The ability of man to adapt himself to

changes in climate has had many important effects. If the Pilgrims had not been able to endure the severe New England winter, the growth of the United States might have taken place in an entirely different manner. If the first Negro slaves had been unable to live in the New World, the history of the American nation would have followed a different course.

As a general rule, man possesses great adaptability, but climatic changes do affect him. A man who goes from a temperate region to the tropics often finds it difficult to preserve his health and vigor. However, intelligent care makes it possible for him to live there for years and carry on his work. See **CLIMATE**.



Italo-American
ACCORDION Accordion Mfg. Co.

ACCOR'DION. This small wind instrument has maintained its popularity since its first appearance in Vienna, in 1829. When played by a skilled performer, it produces rippling music that is delightful for dancing and is always an entertaining feature of music-hall and vaudeville programs. While the accordion is not a regular instrument of the orchestra, it is often seen in amateur and school bands.

The accordion has a central bellows of many folds, with a keyboard on one side and rows of stops on the other. The keys look somewhat like those of a piano keyboard. As the performer works the bellows back and forth and plays the melody and accompaniment with his fingers, air flows through valves to metallic reeds, whose vibration produces the musical tones. The pitch of each note is determined by the size of the reeds. The concertina is an improved form of the accordion. See **CONCERTINA**.



ACETYLENE, *a set' i leen*. This colorless gas, which burns with an extremely hot flame, contributes greatly to the progress of the metalworking industries. Scientists knew about acetylene as a curiosity a century ago. A French chemist, Pierre Berthelot, who had conducted experiments with the gas, gave it the name of acetylene in 1860. In the years that followed, many persons attempted to find ways of making it cheaply and putting it to work, but thirty years passed before any practical method developed and then it was only by accident.

One day, in the year 1892, engineers were testing chemicals in an electric furnace. When they took a mass of melted lime and carbon from the furnace and placed it in water to cool, they noticed that this mixture, which was essentially calcium carbide, acted on the water to release a gas. Experiments with this gas showed that it could be lighted to produce a very hot flame.

When water and calcium carbide meet, a chemical reaction occurs that produces acetylene, C_2H_2 , which is 92.25 per cent carbon and 7.75 per cent hydrogen. Chemically acetylene is the nearest thing known

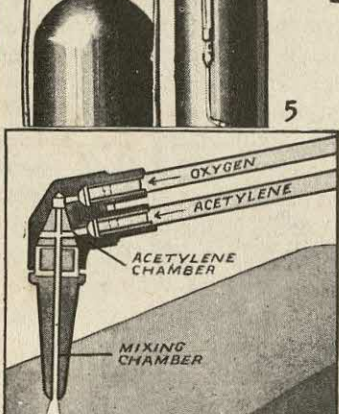
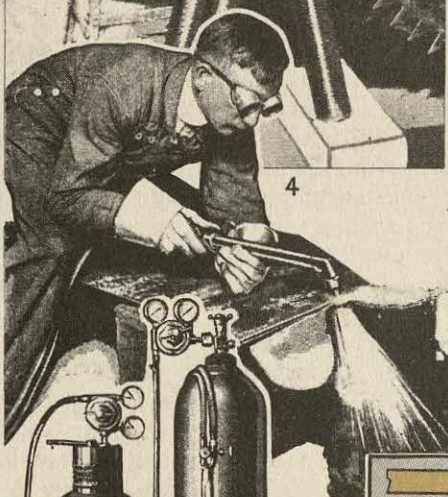
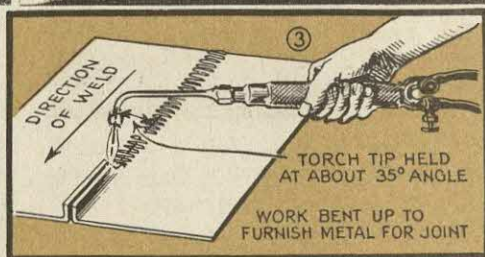
to a gaseous form of carbon. In its pure state it is odorless, but acetylene for commercial purposes may have a disagreeable smell because of impurities resulting from its manufacture.

One of the first uses of acetylene by the general public was for lighting. It was found that the new gas burned with a brilliant white light, much like sunlight. As a result, it was soon used for automobile headlights, street lights, lamps for farm homes, miners' caps, and lighthouses. Even bicycles were equipped with lamps supplied with gas by a small acetylene generator. Today, electricity has replaced acetylene illumination in most places for these purposes, but it is still used for lighting in remote regions where there is no electric supply.

Acetylene light has proved beneficial in hothouses; vegetables and fruits grow faster and larger under lamps than in sunlight alone. Many navigation buoys are lighted by acetylene gas; they can be supplied with calcium carbide and water and left unattended for weeks at a time. Heating is another function of acetylene gas. In rural districts, especially, it gives farm families satisfactory service as a fuel for stoves and heaters.

The most important use of acetylene, however, is in industry. In 1895, three years after the discovery of a process to make acetylene, a French engineer found that the gas, mixed with oxygen, would burn at temperatures as high as 6,000 degrees Fahrenheit, far above the melting point of commercial metals. Six years later, two French engineers used this discovery in perfecting the first oxy-acetylene blowpipe for welding and cutting metals. In welding with this tool, mixed acetylene and oxygen feed from containers through the nozzle of the blowpipe where they are ignited. The roaring flame makes the edges of the pieces of metal to be welded melt and flow together. When cool, they form a solid joint.

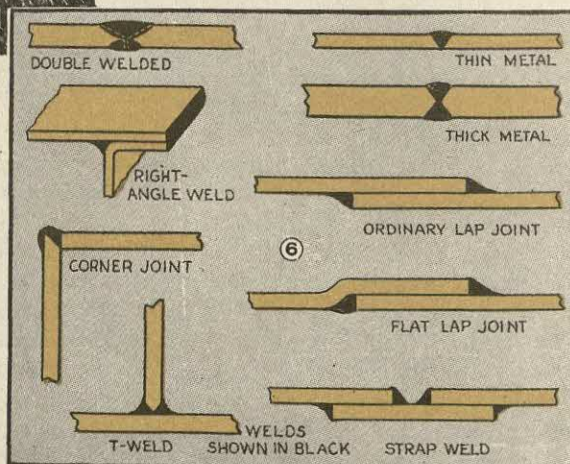
Welding is extremely useful in the manufacture of automobile bodies, ships, and



Courtesy Popular Mechanics

ACETYLENE'S FIERY MAGIC

The metal worker's wand: (1) Repairing broken saw teeth. (2) Welding a right-angle joint. (3) "Sewing up" a seam with molten metal. (4) Slicing sheets of steel with a knife of flame. (5) An oxy-acetylene welding outfit, with gas tanks and blowpipe. The diagram shows how the gases are mixed in the tip. (6) Methods of welding different joints.



airplanes, for it makes metal joints as strong as and sometimes stronger than the separate parts thus united. Thousands of pipe lengths in the great oil pipelines, like that laid from Amarillo, Tex., to Chicago, Ill., are welded into strong, leak-proof tubes by this method, known as oxy-acetylene welding.

By a simple rearrangement of the blowpipe, the oxy-acetylene flame can be changed from a constructive force to one of destruction. Nearly everyone has seen men cutting streetcar rails or steel girders with oxy-acetylene torches. In cutting metals, the oxy-acetylene flame heats the metal until it is red-hot, while an additional stream of pure oxygen sets up a chemical reaction which eats through the metal. The hardest metals can thus be cut as easily with oxy-acetylene torches as a piece of cloth with sharp shears.

The speed and convenience of this welding and cutting process are important factors in the economical production of a thousand and one metal products. Steel filing cabinets, metal furniture, barrels, and storage tanks are just a few examples of articles fabricated by welding. Its uses make the oxy-acetylene blowpipe one of the most important tools in the foundries and repair shops of the world.

ACHAEANS, *a kē' anz*. Long centuries ago, before the Greeks became a great nation, a people called the Achaeans ruled the southern portion of Greece. They were in power for many years, and became one of the four main divisions of the Greeks. After the death of Alexander the Great, more than 300 years before Christ, the rule of the Achaeans was broken, but they regained their power less than a century later. In the year 146 B.C., the Romans conquered the country and dissolved the Achaean kingdom. The Romans called all of Greece, with the exception of Thessaly, Achaea.

ACHILLES, *a kil' eez*. Bravest and best of the Greek mythical warriors was Achilles, son of the sea goddess Thetis. When Achilles was born, his mother heard

a prophecy that he would be killed in battle. To protect him from this fate, she took him to the River Styx. Holding him by the tendon in his heel, she dipped him in the magic waters of the river. Nothing, she believed, could ever harm him thereafter.

Chiron, the Centaur, taught Achilles the art of war and instructed him in music and medicine. At this time the Greeks were waging a great war with the Trojans. Thetis feared that her son would become a warrior, so she disguised him as a girl and sent him to the court of King Lycomedes, where he joined the king's daughters. Ulysses came there disguised as a beggar and spread his wares before the princesses. Suddenly he sounded the alarm of war. The king's daughters fled, but Achilles seized a sword and stood ready to fight, his disguise revealed. It was then an easy matter for Ulysses to persuade him to go to war.

For nine years Achilles fought bravely and joined in sacking many of the Trojan towns. Then Agamemnon, leader of all the Greeks, angered Achilles by taking from him a captive maiden called Briseis. The hero refused to fight and for weeks remained sulking in his tent. Without Achilles the Greeks began to lose battles, but still he refused to go to their aid.

Finally his best friend, Patroclus, pleaded with him to return to the battle. When Patroclus saw that Achilles could not be persuaded, he borrowed his friend's armor and chariot and went forth to fight in his place. Brave Patroclus was killed in a combat with Hector, the great Trojan hero.

Stirred to wrath by the death of his beloved friend, Achilles forgot his grievance. Then Thetis, his mother, went to Hephaestus, the god of metal work, and had him forge new armor for her son. Clad in his bright new armor, Achilles went out to meet Hector, the bravest and best of the Trojan warriors. Not only did he kill Hector, but, as added revenge, he tied his victim's body to the back of his

chariot, and three times dragged it around the walls of Troy.

Apollo, the sun god, was greatly angered by this insult to the great Trojan, and in revenge he guided an arrow from the hand of Paris. The dart struck Achilles in the heel and he fell dead, for when his mother dipped him in the River Styx, the protecting water had not touched that part of his body.

Tendon of Achilles. The strong tendon which connects the muscles of the calf of the leg with the heel received its name from this story of Achilles. This tendon is easy to locate, for it is just above the heel.

ACID, as' id. The tart, sour taste of grapefruit and lemons is due to the citric acid in them. Sourness, in fact, is one of the distinctive qualities of acids. We have a well-known example in vinegar, which contains acetic acid. Acids are ingredients of many foods, and they help to regulate the processes of the body. Some act as laxatives, others as tonics.

Hydrochloric acid, which is present in the gastric juices, is necessary for the proper digestion of many types of food. It may also serve as a disinfectant and kill harmful bacteria that enter the stomach. There are friendly bacteria which help to form lactic acid, the acid that turns milk sour. This acid is important in butter making and it gives flavor to different kinds of cheese.

There are various strong acids that are deadly poisons when taken in large amounts. Among these are oxalic, carbolic, and prussic acids. Carbolic acid is a powerful disinfectant and is useful for cleansing purposes, but if used in the home it should be kept in a bottle labeled "Poison" and put out of reach of children. This should be done with any other strong acids used for household purposes.

All day long we make use of articles whose manufacture requires one or more acids at some stage of the process. Sulphuric acid is employed in tanning the leather of which our shoes are made.

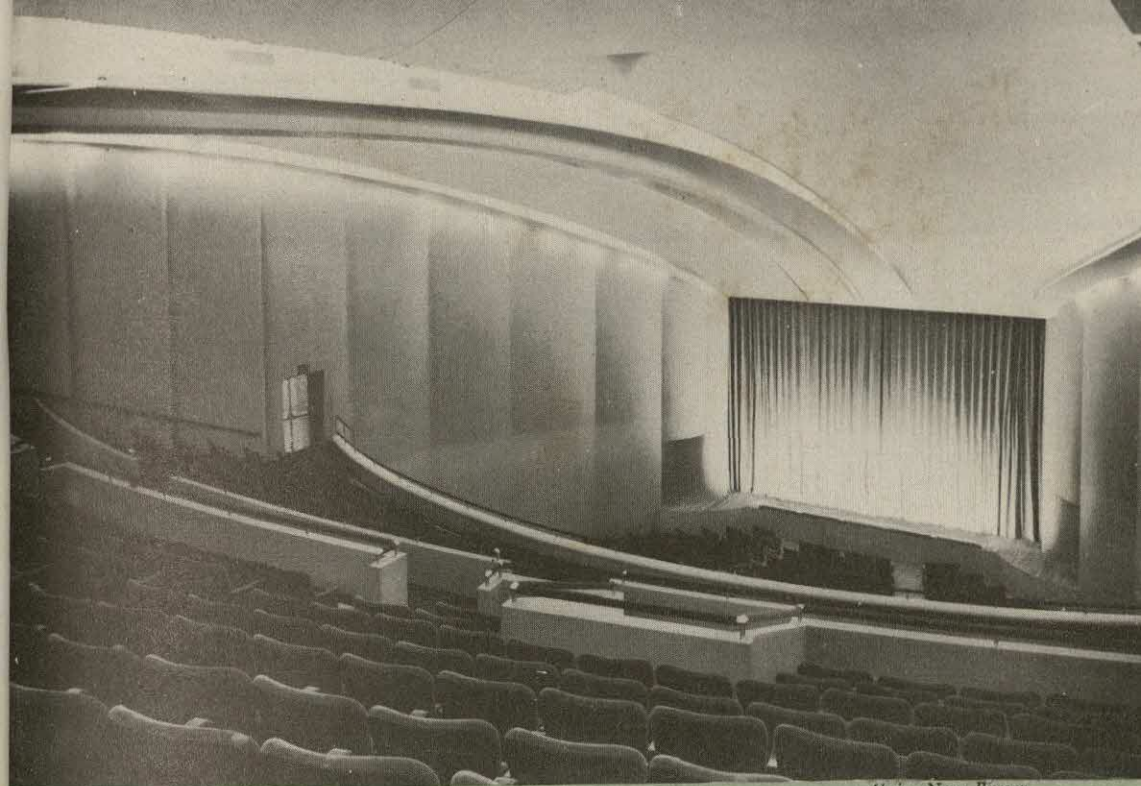
Strong nitric and sulphuric acids are used in the manufacture of celluloid, which is employed for photographic film, backs of brushes, piano keys, combs, toys, and many other objects.

The blue-black ink in your fountain pen may have been made by dissolving indigo in sulphuric acid with scrap iron, and the hard rubber of the penholder is the result of treating rubber juice, or latex, with acetic or some other strong acid. Possibly the holder is made of Bakelite, a hard-rubber substitute whose manufacture requires carbolic acid. Celluloid and Bakelite are but two of the many plastics manufactured with the aid of acids. From plastic compounds are spun rayon, nylon, and other synthetic textile fibers so familiar to us today in brushes, hosiery, and dress fabrics; and here again acids play an essential part. See PLASTICS; SILK, SUBSTITUTE.

Acids are also employed in electroplating, in automobile batteries, in the manufacture of coal-tar colors for dyeing, and in the preparation of explosives, medicines, soap, fertilizers, chemical filter paper, and perfumes. Some of the strong acids are so powerful that they will eat into metal and, consequently, are used in etching steel and copper.

To the chemist, an acid is a compound containing hydrogen that can be replaced by a metal to form a salt. For example, when hydrochloric acid is mixed with sodium hydroxide, hydrogen is replaced by the metal sodium, and sodium chloride, or common salt, and water are formed. The sodium hydroxide is classed as an *alkali*. Acids and alkalies are opposites; and when they are mixed by the chemist, a chemical disturbance is certain to result. In water solutions, acids turn blue litmus, an organic dye, red; alkalies turn red litmus blue. See ALKALI; CHEMISTRY.

ACOUSTICS, a koo' stiks. When sound was added to moving pictures and "movies" became "talkies," hundreds of theaters had to be remodeled so that people could hear, as well as see, from every seat. A theater is said to have good



Union News Bureau

SOUND GETS AROUND

In the memorial Union Theater at the University of Wisconsin, broken surfaces move the sound to all parts of the room. There are no dead spots where sound cannot be heard.

acoustics when music or talking from the stage does not produce echoes, and the sounds can be heard easily from all parts of the house. Acoustics, then, is the science of designing buildings (and also musical instruments, telephones, hearing aids for the deaf, radios, automobiles, and airplanes) so that they will have good "hearing qualities."

Knowledge of acoustics is applied not only to making sounds easy to hear, but also to making them hard to hear; for in noisy places such as large restaurants and offices with typewriters and adding machines, it is important to hinder the carrying quality of sound.

When an auditorium has poor acoustics, the trouble is usually due to echoes that continue for several seconds after the original sound is heard; the result is a confusing jumble of the original sound and the echoes. Engineers who understand the sci-

ence of acoustics can control these echoes in various ways, as by hanging draperies.

Let us try to visualize the process of controlling the acoustics of an auditorium. Instead of an orchestra playing on the stage, or actors speaking lines and sending out sound waves in all directions, let us suppose there are a number of machine guns on the platform, each firing small rubber balls at a very rapid rate. If the ceiling and walls were of some hard and smooth material, the rubber balls would hit the hard surfaces and bounce back in all directions. As the guns kept on firing, the balls would keep on bouncing until the air was full of them. They would soon be striking each other. But suppose that the ceiling and walls were of some very soft material. Then the rubber balls would either stay where they struck, or would drop to the floor without any bouncing whatever.

Scientists have learned, through experimenting, that sounds behave much like the rubber balls of our imaginary auditorium. The waves bounce back when they strike hard, smooth surfaces, and this bouncing back causes echoes. In a place with poor acoustics, the air may be full of interfering echoes.

Material which keeps sound waves from bouncing back is said to absorb the sound. But in a room in which the walls, ceiling, and floor were entirely covered with sound-absorbent material, hearing would be just as difficult as if the whole place were bare, because then all the sound waves would be absorbed. Men who understand acoustics use sound-absorbent material in such a way that just the right amount of the sound is absorbed, to give what they call a "live" effect. They also make allowance for the people who are present in the audience, because the human body absorbs sound waves even more than felt or velvet.

The principles of modern acoustics were discovered about the beginning of the century by Wallace C. Sabine, a professor of physics at Harvard University. At that time, it was found that hearing was very difficult in the lecture room of the new Fogg Art Museum, which the university had just built. Professor Sabine was asked to find out what could be done to remedy the trouble. After many experiments, he solved the problem by covering part of the walls with fabrics to absorb some of the sound waves. Lectures and reports of Professor Sabine telling about his experiments, which he continued for a number of years, are still used as text books on acoustics.

In the United States, some of the places which are most famous for good acoustics include the Mormon Tabernacle in Salt Lake City, Utah; the Hall of Statues in the National Capitol at Washington, D. C.; Saint Paul Cathedral, Detroit; the Boston Symphony Hall, and the Public Auditorium in Cleveland, Ohio. The Mormon Tabernacle and the Hall of Statues

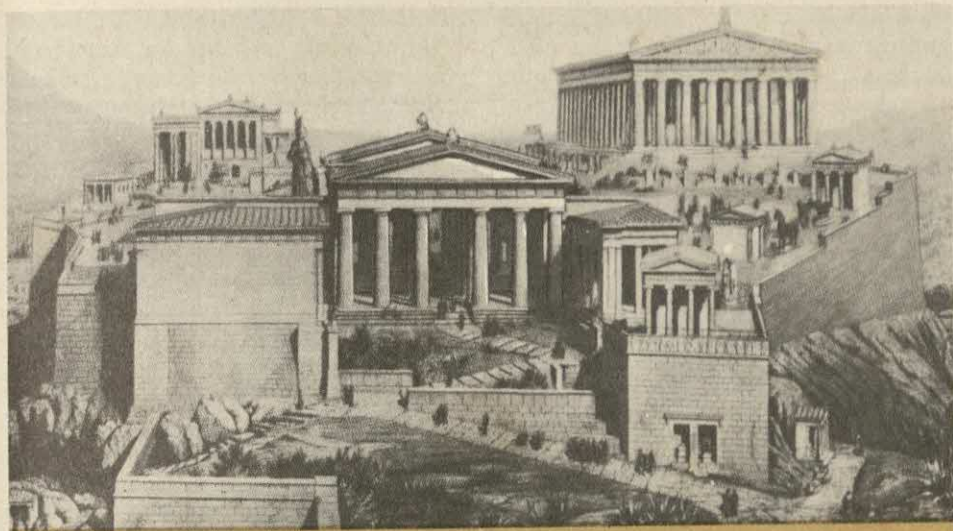
were built before anything was known about acoustics, and became known as "whispering galleries" because even a whisper could be heard from one end to another, although people did not know why this was so. The other places were built after men began to understand acoustics. These later structures were especially designed for good hearing.

Today, when a theater or church is built, as much attention is given to acoustics as to the matter of interior decoration and furnishing. There are many kinds of so-called acoustical material, including felt, cork, different kinds of coarse plasters, and a porous kind of concrete blocks. See SOUND.

ACROPOLIS. As the traveler approached ancient Athens, he could see from afar the noble hill of the Acropolis rising above the walled city. On the highest point of the Acropolis stood the bronze statue of the goddess Athene, patron and defender of the ancient capital. To one side rose a white marble temple, the Parthenon. This magnificent building, the most nearly perfect structure of all time, was built by the famous Greek statesman, Pericles (495-429 B.C.). Among the other beautiful buildings on the Acropolis were the Erechtheum and the Temple of Nike Apteros. To the northwest of the hill was the Theseum. (Each of these buildings is described in this work.)

For hundreds of years the Athenians labored to erect the splendid buildings and statues that adorned the Acropolis. Long after they had lost their ancient power and glory, the Acropolis stood as a monument to their greatness. During the Middle Ages much of the sculpture was ruined. In 1687 the Parthenon, which had served as a Christian church and as a mosque, was partly demolished by an explosion of gunpowder, placed in it by the Turks.

The Acropolis at Athens was the most famous one in Greece, but almost every city had its lofty citadel. Originally the acropolis of each town was the highest piece of land in the vicinity. It was always



THE HEIGHTS OF CLASSIC BEAUTY

The Acropolis at Athens as it looked in the Golden Age of Pericles. The grace and artistic perfection of the Parthenon, upper right, have illumined the world's architecture for all time.

fortified so that the people could easily defend themselves when attacked. When the city itself was fortified, it was no longer necessary to use the acropolis as a fortress, and then began the erection of temples to the gods.

ACTINISM, *ak' tin iz'm*. Sunburn and tan, the fading of bright colors, and the bleaching of linen in strong sunshine are familiar examples of *actinism*. This term is from a Greek word meaning *ray*, and it refers to the chemical or *actinic* properties of the sun's rays. It is these properties that cause our skin to turn red or brown, our clothing to fade, and our linen to whiten when exposed to the sun. There are several other important examples of actinism; some of them have to do with our health.

We know that when we look at a rainbow we are seeing the seven colors of which sunlight is composed—violet, indigo, blue, green, yellow, orange, and red. The rays that make up a beam of white light consist of waves, or impulses, of different lengths. When the raindrops, acting as tiny prisms, separate a light beam into the seven rainbow colors—from violet to red—the eye sees a different color for

every wavelength. In the rainbow, the violet waves are the shortest. Waves that are shorter than violet are called *ultraviolet*. We cannot see them, but scientists know how to make them visible.

It is the ultraviolet rays that cause the chemical changes mentioned at the beginning of this article. They have the special power to act on a substance in the human body and in foods, so that Vitamin D is produced. This is a vitamin that is needed in the diet of children to keep them from getting rickets. Undernourished children are sometimes taken to hospitals and placed in rooms having special glass windows, through which ultraviolet rays can pass. These health-bringing rays cannot pass through ordinary glass, and we cannot get any benefit from them on a cloudy day or in a city with a great deal of smoke. Vitamin D can be produced in milk, cereals, and other foods by exposing them to the ultraviolet rays.

These rays are also important in photography because they have chemical effects upon certain chemicals, making it possible for us to develop the films and plates of the camera. See **LIGHT**.

ADAMS, JOHN (1735-1826). There were whispers of freedom throughout the American colonies when young John Adams finished his course in law and opened an office to practice his profession. And he was one of the first patriots to turn those whispers into the great outcry that was to become the Declaration of Independence. Over forty years later he was elected second President of the nation he helped to found. The key to all that he did in those two score years is to be found in his intense love of American freedom.

His Early Life. The Adams family had been living in what is now Quincy, Mass., for nearly a hundred years when John Adams was born there, October 19, 1735. The great-grandfather of John came to America from England in 1636, during the Puritan migration of that period. The sons of each generation were sent to Harvard College, where John Adams was graduated in 1755. He studied law, was admitted to the bar in 1758, and opened an office in Braintree, Mass. At this time there was strong feeling against England, though public opinion was not as yet demanding revolution and separation from the Mother Country.

In 1765, burning with a strong sense of England's injustice, Adams threw himself into the struggle against the Stamp Act, writing resolutions of protest and presenting them at the local town meeting. Forty other Massachusetts towns adopted these just as Adams wrote them. The year before, he had married Abigail Smith, the daughter of a Congregational minister, and from his wife he received the fullest sympathy and encouragement.

His Public Career. In 1768 Adams moved to Boston, which was to become the fiery center of the agitation against England. In 1770 several English soldiers were arrested for their part in a riot between Boston citizens and the British regulars stationed in the city. Four men were killed in this "Boston Massacre" and feeling ran high. Yet Adams, through a sense of duty, took an unpopular stand

and successfully defended the accused men. That the people appreciated his courage is shown by his election to the Massachusetts legislature in 1771. Three years later, Massachusetts elected him a delegate to the First Continental Congress, which met in Philadelphia on September 5, 1774, to consider the grievances of the colonies. In this body Adams was one of the most outspoken of the few who openly advocated complete separation from England.

His opportunity finally came. Richard Henry Lee's famous resolution calling for a declaration of independence was presented to Congress on June 7, 1776, and Adams seconded it and was appointed to the committee to draw it up. The actual document was largely the work of Jefferson, but it was the inspired zeal of Adams that carried it through Congress. His magnificent speech in favor of the Declaration of Independence brought him fame and public approval, but he also did much quiet committee work through the remainder of his term, which ended in 1778.

During the next ten years, Adams was chiefly in the service of his country abroad. As a member of the commission appointed to draw up a peace treaty with Great Britain, he worked ably with John Jay and Benjamin Franklin to draft terms that were very favorable to the new American nation. This treaty was signed in Paris in 1783. Meanwhile, as American envoy to Holland, he had negotiated a treaty of friendship and commerce with the Dutch government. In 1785 Adams was appointed the first United States minister to Great Britain. The British were none too friendly to the young country that had broken away from their control, and Adams, feeling that he could accomplish little in the face of English coolness and distrust, asked to be relieved. He returned home to receive a great honor.

The First Vice-President. In 1788, in the first election under the Federal Constitution, Adams was chosen Vice-President under Washington. This choice was striking evidence of the esteem in which he



was held, for his honesty and bluntness kept him from having the personal appeal of many of the other patriots, including his second cousin, Samuel Adams. John Adams served as Vice-President during the two terms of the Washington administration, and when Washington refused a third term, Adams was elected his suc-

cessor, thus becoming the second President of the United States (1797-1801). Thomas Jefferson received the second largest number of votes and became Vice-President, according to the electoral plan then in force.

As President. As was to be expected in a new nation, affairs were in an unsettled state, and Adams faced many difficulties as President. His own political party, the Federal, was split by a bitter feud between Adams himself and Alexander Hamilton, who had made a great record as Wash-

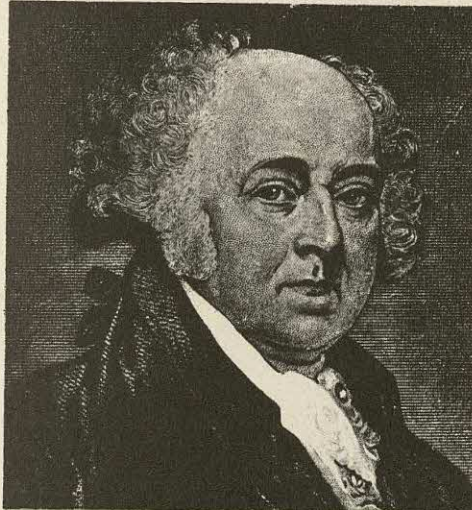
ington's Secretary of the Treasury. The French Revolutionists, who were having trouble with England, had aroused the sympathy of Jefferson and his followers, then called Republicans. They were eager to fight for France and tried to stir up popular feeling against the President, who really favored England but was determined to side with neither country.

Matters soon reached a crisis. Three American commissioners had been sent to France to discuss new treaties with the Directory, then in control of affairs. Talleyrand, the crafty French foreign minister, attempted to exact a large money payment before he would consider any treaties

with the United States. One of the commissioners was reported to have replied, "Millions for defense, but not one cent for tribute!" When the facts were made public, the American people were filled with the spirit of war. Washington was recalled from his home as commander-in-chief, and a few naval battles were

actually fought. In one of these, the *Constellation* sank the French frigate *La Vengeance*. This so-called "Quasi-War" ended quickly, and when the Directory was overthrown, the difficulties between the two countries were settled with Napoleon, who had become First Consul.

The Federal party had been steadily losing favor with the public, and its downfall was made certain by the passage of the Alien and Sedition Laws. These four historic acts were passed by Congress in 1798, when the war spirit ran high. One of the



JOHN ADAMS

Second President of the United States
Administration, 1797-1801

John Adams followed George Washington in the highest office in the land. His administration marked the beginning of the two-party system, centering in bitter conflicts with Hamilton and Jefferson.

Alien Laws provided that the President could deport any foreigner who might be a menace; the Sedition Law provided that anyone libeling the President, the government, or Congress could be fined or imprisoned. Opposition to these laws was immediate and widespread. They were denounced as violations of the rights of free speech and a free press, as provided by the Constitution. The legislatures of Kentucky and Virginia passed resolutions declaring the laws unconstitutional, and asked other states to join with them in calling them null and void. In the Kentucky and Virginia Resolutions we have the first assertion of the doctrine of states' rights, of

which so much was heard before and during the Civil War.

The year 1799 marked the death of George Washington, the nation's first citizen. A year later the national capital was moved from Philadelphia to Washington, D. C., then almost a city in the wilderness. Adams lived only a few months in the newly built house for the Presidents. The tide of feeling against the Federalists carried the Republicans (later called Democrats) to victory in the election of 1800, Adams being defeated by Jefferson. One of the last acts of his administration was his appointment of John Marshall as Chief Justice of the Supreme Court. This appointment was one of the most important events of Adams's term, for it was Chief Justice Marshall who established the principle that laws of Congress shall be subject to review by the Supreme Court.

Later Years. Bitterly disappointed at his failure to be re-elected, Adams enjoyed a belated consolation, in the closing years of his life, in seeing his son, John Quincy Adams, elected sixth President of the United States. After his retirement from public life, he lived quietly in Quincy, and in time became a close friend of his former opponent, Thomas Jefferson. Fitting it was that two such illustrious men should have died on the same day—July 4, 1826—the fiftieth anniversary of the very Declaration of Independence that owed so much to both of them. Unaware that Jefferson had died a few hours earlier in Virginia, Adams uttered in his last words a noble tribute to his friend, "Thomas Jefferson still survives."

ADAMS, JOHN QUINCY (1767-1848). Only once in the history of the United States have a father and son both held the office of President. John Quincy Adams, the sixth President, was the oldest son of John Adams, the second President. Like his father before him, John Quincy Adams served in Europe as a diplomat and held important offices under the American government at home. Both were stubborn in matters of conscience and principle,

and both were blunt of speech and often lacking in tact. While such qualities kept them from being popular in their day, historians place the elder and the younger Adams among our outstanding Presidents.

Education and Early Career. John Quincy Adams was born on July 11, 1767, in the family home at Quincy, Mass. When he was eleven he went to Europe with his father, and for a few years attended school in France and in Holland. Then, in 1785, at the age of eighteen the son returned home to enter Harvard College. He was graduated in 1788, studied law, and in 1791 opened an office in Boston. Adams did not go far in law. He was more interested in events of the day than in clients. The able papers that he wrote on public questions attracted the attention of President Washington, who appointed him United States minister to Holland in 1794.

When John Adams became President, in 1797, he sent his son to Berlin, and the younger Adams served as minister to Germany until the end of his father's term. On his return to Massachusetts, in 1801, John Quincy was elected to the state senate. Two years later he entered the United States Senate.

Adams was supposed to be a Federalist, like his father, but his heart was with President Jefferson, who headed the Republican party of that day. (This party later took the name Democratic, which it still bears.) Adams, always voting according to his conscience, enraged his New England friends by supporting the Embargo Act of 1807. This act forbade American ships to trade with any foreign country, because of the high-handed methods of France and England on the sea. It was ruinous to the shipping of New England, and several months before Adams's term was over, Massachusetts elected a new Senator in his place. He thereupon quietly resigned.

He was teaching rhetoric at Harvard in 1809, when James Madison succeeded Jefferson as President. The new President at

once appointed Adams minister to Russia, and he remained at the Russian capital, Saint Petersburg, until 1814. That year he helped to draft the treaty of peace with England, following the War of 1812. His father had done his country a similar service after the Revolutionary War; and, like John Adams, the son remained in England as the resident minister. Within two years he was called back to America by President Monroe to serve as Secretary of State. In that position Adams had a leading part in the work on the Monroe Doctrine.

Sixth President (1825-1829).

Adams was one of four candidates for the office of President when Monroe retired after two terms. The election was so close that no one received a majority of the electoral votes, and the House of Representatives had to make a choice from the three highest. Adams was second and Henry Clay fourth; and when Clay, the great orator, asked his followers to vote for Adams, the latter was elected.

Andrew Jackson, who had stood first, unjustly accused Adams and Clay of making a political bargain, for Adams at once appointed Clay Secretary of State. Throughout this administration there was bitter strife between two factions—the Adams men, or National Republicans, and the Jackson men, who came to be known as Democrats.

The most important act passed during the administration of Adams was the

tariff law of 1829. This placed duties on goods imported into the United States and thus made them more expensive. The agricultural people of the South resented this act very bitterly and called it the "Tariff of Abominations." It simply

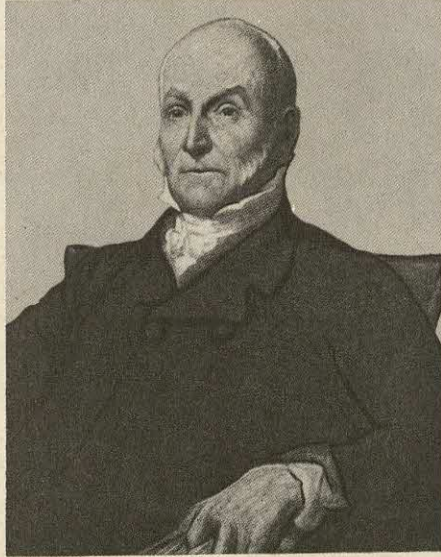
helped the manufacturers of the North, they said, at the expense of the South. The Democratic South thus became the center of the free-trade movement, while the North generally favored protection.

Other events of the administration include boundary disputes between Mexico and Great Britain, and a struggle with the Federal government and Georgia over the control of Indian lands. In 1825 the Erie Canal was completed and Bunker Hill Monument begun. The first railroad in the country, between Quincy and Charlestown,

Mass., was opened in 1826. In 1829 Webster's *Dictionary* was published.

While the administration of Adams seemed to be a failure, he stood for a principle that we hear much about today. He believed that the unsettled lands of the West and the natural resources of the country rightly belonged to the people and should be utilized for the public good. He hoped that the nation would take a stand against private use and waste of these resources. He wanted large sums appropriated for roads, canals, and other public improvements.

The people showed little interest and Congress appropriated only \$14,000,000,



JOHN QUINCY ADAMS

Sixth President of the United States
Administration, 1825-1829

John Quincy Adams was the only President in American history whose father held the office before him. His administration saw the establishment of the first American railroad and completion of the Erie Canal.

but conservation of the nation's resources and public improvements are among the live questions of today. Time has justified Adams's stand, and for that reason he is honored by modern historians.

The Later Years. As the unpopular candidate of the National Republicans, Adams had no chance of defeating the energetic and popular Andrew Jackson. On Jackson's election to the Presidency, he retired to private life, but in 1830 he was elected to the House of Representatives. John Quincy Adams is the only man in American history who served in Congress after his administration as President. He felt that it was an honor, he said, to serve the people in Congress or even in a town meeting. For seventeen years he was an outstanding member of the House.

The First Amendment to the Constitution, in the section called the Bill of Rights, states that Congress shall make no law abridging the right of the people to petition the government for a redress of grievances. When Congress adopted a series of "gag rules" to ignore the frequent petitions against slavery, Adams began a fight that lasted from 1836 to 1844. In the latter year he finally won his battle and saw the rules withdrawn. The "Old Man Eloquent" died in harness, as the saying is. On February 21, 1848, he suffered a stroke of paralysis while sitting at his desk in the House. He lived only two days.

ADAMS, SAMUEL (1722-1803). In the patriotic movement that led to the Declaration of Independence, no family was more devoted than the Adams family of Massachusetts. Samuel Adams, who was the second cousin of President John Adams, was one of the most ardent of the Revolutionary patriots. He was born in Boston, was graduated at Harvard in 1740, and after leaving college he became active in the political affairs of his city.

When the colonies began protesting against the Stamp Act, in 1765, Adams wrote a paper upholding the principle that taxation without representation is tyranny, which was sent to the Boston delegates in

the Massachusetts colonial legislature. He was a member of the lower house from 1765 until 1774, and during that period he continuously drafted papers and wrote letters urging opposition to England, and he led public meetings, organized the first committee of correspondence, drafted the Boston Bill of Rights, and took a leading part in the Boston Tea Party. The English commander, General Gage, sent soldiers to arrest him and John Hancock, in April, 1775, a movement that led to Paul Revere's ride and the battles of Lexington and Concord.



SAMUEL ADAMS

From 1774 to 1781, Adams sat in the Continental Congress. He was a signer of the Declaration of Independence, and was a delegate to the Massachusetts convention that ratified the United States Constitution. From 1794 to 1797, he was governor of Massachusetts.

ADDAMS, JANE (1860-1935). In one of the poorer sections of Chicago, where there are many foreign families, is the social settlement called Hull House. Jane Addams, its founder and its head resident for forty-six years, was born in Cedarville, Ill. After her graduation from Rockford (Ill.) College in 1881, she studied in Europe and at the Women's Medical College in Philadelphia. When she came to Chicago, in 1889, she knew what her life work was to be, and with the help of a close friend, Ellen Gates Starr, she started the social center that has done so much for the poor of a great city. (How Hull House is managed and the story of its activities will be found in this work under the title HULL HOUSE.)

Miss Addams was interested in a great variety of public questions. In 1909 she was president of the National Conference of Charities and Correction, and she was



A LEADER IN COMMUNITY SERVICE

The dedicated work of Jane Addams helped to bring about many social and political reforms.

a leader in the movement to permit women to vote. In 1912, when Theodore Roosevelt ran for President as a Progressive, she seconded his nomination at the convention held in Chicago. She worked to improve the tenements in which the poor had to live; she showed the need of clean streets and alleys in the slum districts; and she spoke and wrote against child labor. Throughout her public career, Miss Addams labored for peace among the nations, and in 1931 she was awarded half of the Nobel Prize for Peace, sharing it with Nicholas Murray Butler, president of Columbia University.

The ideals and experiences of this great woman are presented in the many books that she wrote. These include *Newer Ideals of Peace*, *The Spirit of Youth and the City Streets*, *Twenty Years at Hull House*, *The Second Twenty Years at Hull House*, and *The Excellent Becomes the Permanent*.

ADDING MACHINE. See CALCULATING MACHINES.

ADDIS ABABA, *ah'dis ah'bah bah*. On the slopes of the Entoto Mountains, in the central part of Ethiopia, is Addis Ababa, capital of the Ethiopian Empire.

The city is located in the province of Shoa, at an altitude of about 8,000 feet.

In May, 1936, the forces of Emperor Haile Selassie surrendered to Italian invaders, and Addis Ababa became the capital of Italian East Africa. In 1941 the British reconquered the colony and restored Haile Selassie to his throne.

When founded by the Emperor Menelek, in 1892, the place was a typical settlement of backward tribesmen, with no regular streets and with deep ravines cutting it into various sections. Later, stone public buildings and a modern capitol were erected by the government. The palace of Haile Selassie stands on a hill in the center of the town. Addis Ababa is connected with Djibouti, in the French Somaliland, by a railway 487 miles long. The city is connected with other parts of Ethiopia and the outside world by airways and wireless and is the hub of the nation's expanding highway system.

Ethiopia's first institution of higher learning, a university college, was opened in the capital in 1950. Also there are the Houses of Parliament, the National Library, and other government buildings, and several hospitals and Christian churches. Population, about 500,000.

ADDISON, JOSEPH (1672-1719). In the days of this famous English essayist, the people of England had no popular daily newspapers or fiction magazines, and the first modern novel, *Robinson Crusoe*, was not published until the year of his death. We remember Addison especially because of his wonderful essays containing stories, political views, and observations on everyday life, which were issued in periodicals not unlike the magazines of today. He was one of the first great English journalists, and the modern novel, as well as the modern periodical, owes much to him.

Addison was the son of a minister of the Church of England, and was born in his father's rectory in Milston, Wiltshire. As a boy he attended the Charterhouse School in London, where Richard Steele, another great essayist, was a classmate.

Addison entered Oxford University at the age of fifteen. While in college he received much praise for his skill in writing Latin verse. A Latin poem that he composed in honor of the treaty of 1697 so pleased King William that the author was given a pension of \$1,500 a year. This ended when the king died, in 1702, but Addison received a good political position in 1704 by writing a poem in praise of the Duke of Marlborough, who had won a great victory over the French and Bavarians at Blenheim. Nearly all of his life he was in the government service, but he did not let his duties interfere with his writing.

Addison's school friend, Richard Steele, began publishing a small periodical called the *Tatler*, in April, 1709. This was issued three times a week and each number sold for a penny. It contained foreign and theatrical news, and talks on literature and current affairs. Addison at first offered advice, then contributed essays, and had written forty-two of the remaining numbers when the *Tatler* was discontinued, in January, 1711. Early in March the first number of the famous *Spectator* appeared.

The two essayists had made it appear that the *Tatler* was written by various social clubs, men who gathered at the London coffeehouses for food and conversation. The papers of the *Spectator* were supposed to be written by members of the Spectator Club, the leader being "Mr. Spectator." During the two years of its existence, Addison wrote about half of the *Spectator* numbers. These essays are the best work he ever did. His graceful style, his kindly humor, and his shrewd observations on the customs and manners of his time make the *Spectator* extremely readable today. Of the characters Addison described, none surpasses the delightful country squire—Sir Roger de Coverley.

Addison's political drama in verse, *Cato*, was very popular when produced, but it is not the kind of poetry read today. More enjoyable is his hymn, beginning—

The spacious firmament on high,
With all the blue ethereal sky,
And spangled heaven, a shining frame,
Their great original proclaim.

ADIRONDACK, *ad i ron'dak*, **MOUNTAINS**. Famed for their varied and rugged beauty, popular as a vacation land for camper, hunter, and fisherman, and valued for their forest and mineral resources, the Adirondacks occupy an area of over 12,000 square miles in Northeastern New York. These mountains are often described as a part of the Appalachians, but they are really an independent system of picturesque ranges, valleys, lakes, and streams.

To preserve their scenic beauty and valuable forests, the state of New York has created a public park in the very heart of the Adirondacks. Included in this preserve is the highest peak in the range, Mount Marcy, rising 5,344 feet above sea level. Among the best-known lakes in the Adirondacks are Champlain, George, Placid, and Saranac. Many splendid resorts are located in the area.

ADJECTIVE. In the sentence "Columbus crossed the Atlantic Ocean with ships," only the simplest facts of the voyage are told. Let us change the sentence to read: "*Brave* Columbus crossed the *stormy* Atlantic Ocean with *three small sailing* ships." All of the added words are adjectives, and it will be noted that each one gives further meaning to a noun or a phrase used as a noun. This is the purpose of adjectives. By limiting or modifying nouns they make language more vivid, more interesting, or more precise. Talking, writing, and reading would indeed be very colorless if we had no adjectives.

In the second sentence above, *brave*, *stormy*, *small* and *sailing* are classified as *descriptive* adjectives; *qualifying* is another name for these adjectives that answer the question "What kind?" The term *three* is classed as a *limiting* adjective, for it answers the question "How many?" These are the two general classes of adjectives.

Such words as *this*, *that*, and *those* are used like adjectives to modify nouns, and are called *pronominal* adjectives by some grammarians. Others regard them as



Courtesy Santa Fe Railroad

SUN HELPED TO BUILD THESE INDIAN HOMES

Pueblos of the Southwest have been built for centuries of the same kind of sun-baked brick that was used by the architects of ancient Babylon.

adjective pronouns. To compare descriptive adjectives, we add *er* and *est* to the positive form in case of simple words, as *kind*, *kinder*, *kindest*. Longer adjectives usually are compared by the use of *more* and *most* and *less* and *least*, as *fortunate*, *more fortunate*, *most fortunate*; *dangerous*, *less dangerous*, *least dangerous*. Some adjectives undergo a complete change of form, as *good*, *better*, *best*. See ADVERB.

AD'MIRALTY. In general, the word *admiralty* refers to affairs pertaining to the sea. However, in Great Britain the Admiralty is the executive office, or Ministry, which has charge of naval affairs, the head official being called First Lord of the Admiralty. The name also is given to a system of courts which have authority over all questions concerned with the sea—such as maritime contracts, collisions, or prizes of war. There are no admiralty courts like these in the United States, all cases which have to do with the navigation of the public waters being handled by the United States district courts.

ADOBE, a *doh'be*. Throughout the dry regions of Arizona, New Mexico, and Old Mexico may be seen odd flat-roofed houses

that look as if built of clay. These are the *adobe* houses of the Indians and Mexicans of the Southwest. The bricks that form the walls are made of a clayey earth, also called *adobe*, which can be readily molded when wet. The material while moist is mixed with straw or other fibrous matter. These *adobe* bricks are the best and cheapest material in dry countries, where there is usually little stone or wood. Too much rain would cause the bricks to fall apart, and *adobe* houses are therefore practical only in arid regions.

Like the sun-dried mud bricks used by the ancient Egyptians and Babylonians, *adobe* bricks are baked in the sun instead of in ordinary kilns. After being molded, they are exposed to the sun's rays for ten days or longer, and are turned over during the baking once a day. The Indian and Mexican women usually attend to this work, and they also help in building the houses. The bricks are of various sizes. *Adobe* houses are cool in summer and warm in winter, and the material is being used in connection with stucco in some of the better homes in Southern California.

ADONIS, *a doh'nis*. In the ancient myths of the Greeks and Romans, Adonis was a handsome youth who was beloved by Venus, the beautiful goddess of love. Adonis, so the story goes, was killed during a boar hunt. The grief-stricken Venus begged the gods to permit the youth to return from the underworld, and they finally agreed to have him brought back to earth for six months of the year. This story typifies the death of plants in winter and their awakening in spring.

ADRIANOPE, *ay drih an o' p'l*. Hadrian, a Roman emperor of the second century, enlarged and fortified a small town in European Turkey during his reign. Anciently called Hadrianopolis, then for centuries Adrianople, it is now named Edirne (*eh dir' neh*). It lies near the Turkish-Bulgarian border some 130 miles northwest of Istanbul (Constantinople), with which it is linked by a paved highway and by the railroad connecting Istanbul with Sofia and Belgrade. Edirne is one of European Turkey's most important cities.

The Romans lost the city to the Visigoths, a powerful German tribe, in 378. Later it was captured by the Bulgarians and by the Crusaders. It became Turkish in 1361. From then until the Turks captured Constantinople in 1453, Adrianople was the capital of their sultans and a great trading center. After taking the city in 1829, the Russians forced the Turks to sign a treaty there, in which Turkey granted independence to Greece. The city was again held briefly by the Russians in 1879, by the Bulgarians in 1913, and by the Greeks after World War I. Each time Turkey regained it.

Edirne is still an Oriental-looking city, with crooked, alleylike streets lined with ancient wooden buildings, and with mosques and bazaars. Yet it is the market center for a large farming and fruit-raising area, is noted for its cheese, candy, and wines, and also makes and exports silk, cotton, and woolen goods, attar of roses, and "turkey red" dye. Its population is about 30,000.

ADRIATIC, *a dre at'ik*, **SEA**. Between Italy on the west and Yugoslavia and Albania on the east lies the Adriatic, an important arm of the Mediterranean Sea. The Adriatic extends in a northwesterly direction from the Strait of Otranto, which is at the southeastern tip of Italy. The sea is about 480 miles long, its average width is 100 miles, and its area is about 60,000 square miles.

At its northern end are two gulfs. On the shore of the westerly one, the Gulf of Venice, lies the city of Venice, "Queen of the Adriatic." On the Gulf of Trieste, to the east, is the historic city of Trieste. The Italian coast line of the Adriatic is chiefly low and marshy, and there are few suitable harbors. The Yugoslavian coast line, however, is rugged, with many inlets. See **VENICE**.

ADVERB. As its name implies, an adverb is a part of speech that is used with a verb to give it added meaning. The sentence "John reads" carries one thought, but if we add one of several adverbs, such as *rapidly*, *slowly*, *seldom*, or *often*, we get an entirely different idea. Adverbs so used are said to limit or modify; they may modify adjectives and other adverbs, as well as verbs, but they never limit nouns or pronouns.

In regard to meaning, there are seven principal kinds of adverbs: (1) Adverbs of place, as *here*, *there*; (2) of time, as *now*, *again*; (3) of number, as *once*, *first*; (4) of manner, as *bravely*, *fast*; (5) of degree, as *very*, *more*; (6) of cause, as *why*, *wherefore*; (7) of assertion or denial, as *yes*, *no*.

Most adverbs ending in *ly* are compared by the use of *more* and *most* or *less* and *least*, as *gently*, *more gently*, *most gently*; *bravely*, *less bravely*, *least bravely*. When the adverb has the same spelling as the corresponding adjective we compare by adding *er* and *est*, as *long*, *longer*, *longest*. A number of adverbs have an entire change of form when compared, as *well*, *better*, *best*. This is called irregular comparison. See **ADJECTIVE**.



General Outdoor Advertising Co., Inc.

ADVERTISING. Suppose a schoolboy wanted to sell a camera or a coin collection; how would he go about it? He might trudge around to all his friends, visiting them one by one until he found a buyer. That might take many days. A quicker way, his teacher permitting, would be to pin a notice on the school bulletin board. Then everyone in the school would know that there was something for sale, and buyers would come to the seller. This method of offering things for sale is what we mean by advertising; and it carries with it the idea of reaching many people at once.

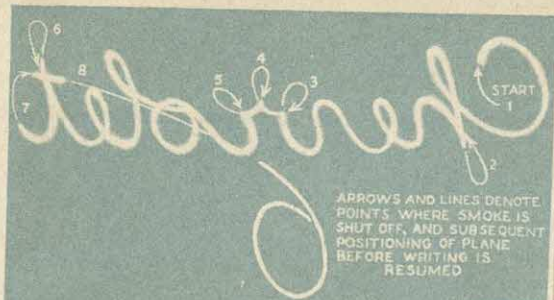
A Natural Development. We must go back many centuries to find the beginnings of advertising. In the simple life of our primitive forefathers there was no need of it. People raised their own food, made their own garments, and bartered with their neighbors to satisfy their few wants. In the course of time, commerce began, and men gathered together in towns and cities. Then there must have been competition between merchants, and the need of reaching many people at once. That advertising was used in ancient times is known from a papyrus or paper scroll dug up by modern scientists from the ruins of the Egyptian city of Thebes. This scroll carries an advertisement for the capture of runaway slaves. It is the coun-

terpart of the newspaper notice of today, advertising for the return of lost pets.

The Romans in the days of the empire put up tablets on pillars to announce gladiator contests and chariot races—like the modern poster announcing the circus or the world-series baseball games. Centuries later came the invention of the printing press, which was a great spur to advertising. An old German newspaper in 1591 carried notice of a public sale offering ivory, sugar, pepper, tobacco, and logwood. Soon after that, such notices were common in England, where many odd forms of advertising were practiced.

Town criers walked the streets of old London, crying the wares of shopkeepers. It is said that some merchants stood in their doorways trying to "outbawl" each other. The "sandwich" man of the modern city, carrying an advertisement on his back, fulfills the duties of the old town crier, but silently. And the "barker" of the circus or carnival reminds us of the "bawling" merchant. To that period belongs, too, the custom of hanging out signs describing a trade or wares; for instance, there was a big boot for the shoemaker, a red lion for the innkeeper.

Quantity Selling for Quantity Manufactures. Advertising today has a definite influence on our way of living. It tells us about thousands of articles and



Courtesy Outdoor Advertising, Inc.

services. It enables us to get more value for our money because it helps the manufacturer to find many customers quickly, and thus use large-volume production to make his articles at lower cost.

The speed with which advertising reaches millions of people shortens the period between the invention of thrilling new things and the time when they can be enjoyed. Once it took a lifetime for an invention to come into common use. In less than ten years after the electric refrigerator was first made, millions were enjoying this home convenience, thanks to advertising. Advertising also keeps goods flowing through the channels of modern commerce—from factory to warehouse to store to the home. In so doing it helps to keep workers employed in tens of thousands of companies.

The Power of Advertising. The most interesting phase of advertising is its personal appeal, for every advertisement is planned to attract our attention and make us want something. Miles away, in some



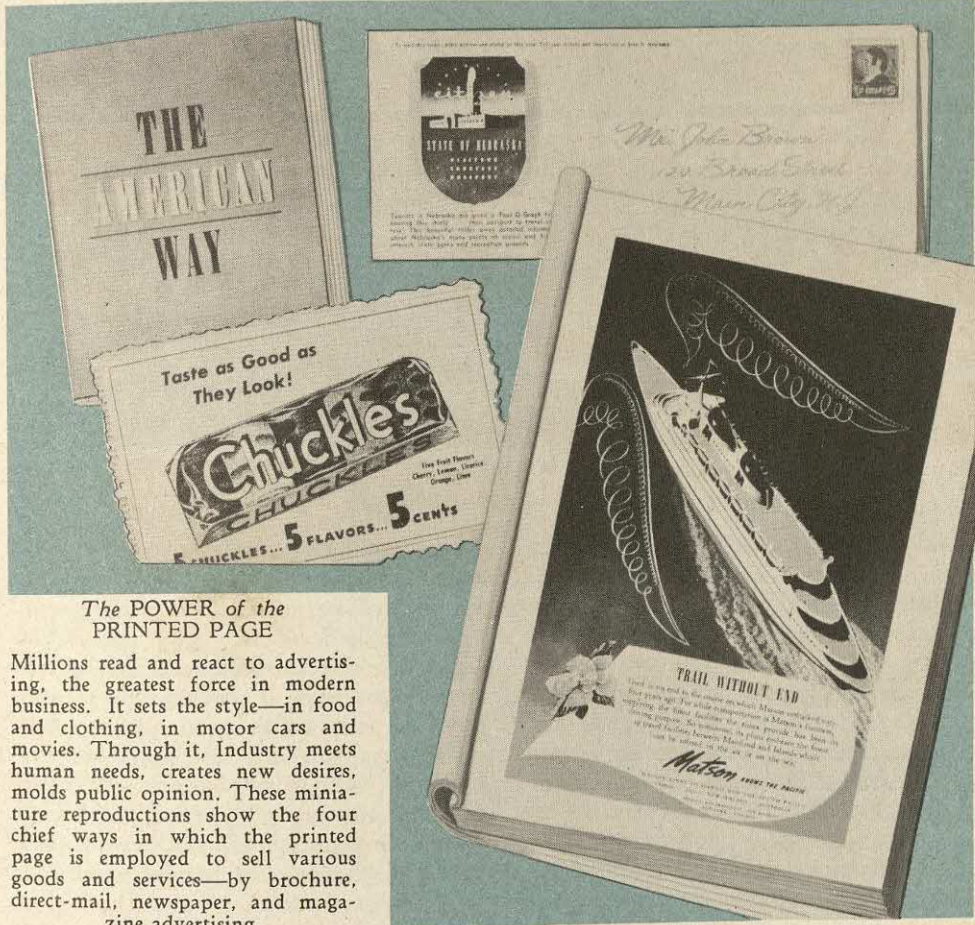
EYE APPEAL TO THE POCKETBOOK

Sky writing (upper left). An airplane spreads a product's name across the sky in smoky letters a mile high. Billboards, packages, and posters are able, silent salesmen, both indoors and out.

distant city, perhaps, a writer has us all "figured out." It is true; he knows us better than we know ourselves. Suppose he is trying to sell bicycles. He realizes that any of us able to buy a new bicycle would want one that would be the envy of our friends. Without our realizing it, he puts just the right words under an appealing picture—the picture of a bicycle that is sturdy, beautifully enameled, equipped with all the latest accessories. When we see his handiwork in our favorite magazine, what happens? We get to wanting that particular bicycle.

Advertisers use many different lines of approach to secure customers for their wares. Insurance companies appeal to man's desire to protect his family from want. Food manufacturers appeal to the appetite, showing real-life pictures of luscious fruit, or tempting dessert, or nourishing breakfast food. We are urged to earn money, save money, budget for the future; to be happier, take life easier, sleep more comfortably at night; to be stronger or healthier; to be like others or different from them; to acquire new friends or avoid losing old friends.

Advertising today may be thought of as an invisible branding iron. Over and over



The POWER of the PRINTED PAGE

Millions read and react to advertising, the greatest force in modern business. It sets the style—in food and clothing, in motor cars and movies. Through it, Industry meets human needs, creates new desires, molds public opinion. These miniature reproductions show the four chief ways in which the printed page is employed to sell various goods and services—by brochure, direct-mail, newspaper, and magazine advertising.

it impresses upon us the name of a product until it is so burned into our minds that we are eager to own that particular product and feel that no other could be so good.

Selling Through Many Media. The media (forms, or channels) of advertising are many. Newspapers, magazines, radio, television, and billboards—all these media are very familiar today. In cities, brilliant electric and neon signs and elaborate window displays advertise goods and services. We see advertisements on cans and packages, in buses, on movie screens—and even in the sky, when airplanes write them with “smoke” or advertisement-carrying blimps fly overhead. Letters, folders, and booklets carry advertisements through the

mail. Even the telephone is used to urge us to buy. Both radio and television bring us entertaining and educational programs so that we will give our attention to their accompanying *commercials*, as their advertisements are called.

Truth in Advertising. Most newspapers, magazines, and broadcasting stations carefully avoid presenting misleading or false advertising. In the United States, the Federal Trade Commission stops untruthful advertising, the Federal Food and Drug Act forbids manufacturers to use misleading labels on containers, and laws prohibit the sending of untruthful advertising through the mail. Other countries have similar laws and agencies for protecting the public against fraudulent advertising.



AENEAS TELLS THE STORY OF THE FALL OF TROY

The warrior hero of Vergil's epic recounting his adventures to Dido, queen of Carthage.

AENEID, e ne' id. One of the greatest adventure stories of all time is this epic by the Roman writer Vergil. It sings, as the very first words tell us, of "arms and the hero," *Arma virumque cano*. Against a brilliant background of war and battle on land and sea, of mighty gods and goddesses, it tells the tale of the Trojan warrior, Aeneas. In it are all the wonderful color and imagination of the ancient world.

The poem is essentially the story of the wanderings of Aeneas after the fall of Troy, his founding of Rome, and a prophecy of Rome's future greatness. The hero himself undoubtedly personifies Vergil's conception of the ideal Roman, and the underlying purpose of the poem is to glorify the greatness of Rome—sprung from a humble past, yet growing in power until it became the world empire of Augustus, during whose reign Vergil composed his classic work.

The story opens in what is called the epic manner; that is, in the middle of the action. The vengeful Juno has caused a storm to drive the ships of Aeneas ashore, near Carthage in Africa, after the hero has been six years in his wanderings. Dido, the queen of Carthage, receives him graciously and is caused by Cupid to fall in love with him.

Here the story shifts back to the beginning, as Aeneas tells Dido the history of his travels. The second book of the poem is particularly vivid, telling as it does the tale of the wooden horse and the fall of Troy, the burning of the city, and all the terrors of that fateful night. Aeneas himself escapes, carrying his father on his shoulders; later he attempts a settlement in Crete, and receives several prophecies of his future destiny. His father, Anchises, dies in Sicily and the hero's connection with Troy is severed.

The tale then returns to Carthage, where Aeneas is commanded by the gods to depart. Dido, in despair, kills herself as the Trojans set sail for Italy. The fleet is driven ashore in Sicily and set on fire, but again Jupiter intervenes to help Aeneas. Eventually he reaches Italy, where the Cumaean Sibyl leads him through the infernal regions. There he meets his father Anchises and learns from him of the future in store for him and his descendants, the Romans.

Aeneas comes to Latium in Central Italy, where he makes a treaty with the king and is promised his daughter Lavinia in marriage. Juno again attempts to cause the downfall of the Trojans by causing a war with the neighboring kings, but Aeneas is victorious; and on that note of

victory the *Aeneid* ends.

The *Aeneid* is in twelve books, the first six of which, dealing with the wanderings of Aeneas and the fall of Troy, are modeled after the *Odyssey* of Homer; the last six deal with the conquest of Latium. The epic is written in Latin verse of six feet—the dactylic hexameter, which reached its perfection in Vergil and which Longfellow used in writing *Evangeline*. See DIDO; MYTHOLOGY; VERGIL.

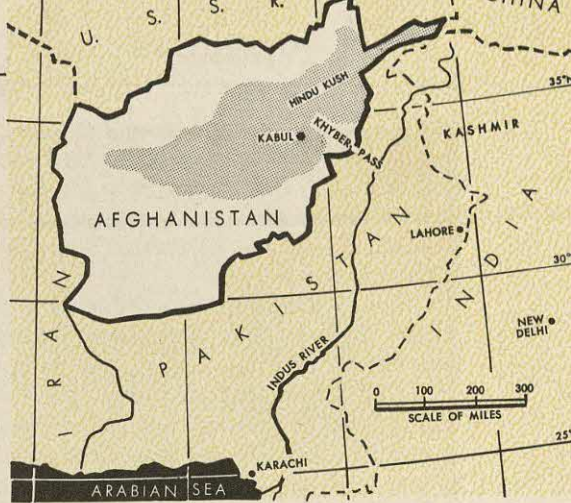
AEOLUS, *e'olus*. According to Greek mythology, the winds were kept confined in a cave in the Aeolian Islands. They were guarded by the god of the winds, Aeolus, who released them when he wished or when he was commanded to do so by superior gods. The winds, who were the sons of Aeolus, were named Boreas, the north wind; Corus, the north-west wind; Aquilo, the northeast wind; Notus, the south wind; Eurus, the east wind; and Zephyrus, the west wind.

AERONAUTICS, *a ur o naw'tiks*. See AIRPLANE; BALLOON; DIRIGIBLE BALLOON; FLYING, STORY OF.

AESOP, *e'sop*. Of the fables that have come down from the ancients, probably none are more widely known than those of Aesop. His little anecdotes about animals that think and act like human beings are loved by both adults and children. Indeed, they have given us such familiar expressions as "wolf in sheep's clothing," "sour grapes," and "dog in the manger."

Aesop is said to have been a Greek who lived about the middle of the sixth century B.C., although it is possible that he was a purely legendary character. Antiquity's richest man, Croesus, and wisest man, Solon, lived at this time. Aesop visited the court of Croesus, and he is also said to have visited the wise ruler, Pisistratus, at Athens. Croesus sent him to Delphi with a sum of money for the citizens but, for some unknown reason, he failed to distribute the money, and the Delphians, enraged, threw him from a precipice and killed him.

Several collections of Aesop's fables have



MOUNTAINOUS MOSLEM STATE
With its two Moslem neighbors, Afghanistan stands between Russia and the Arabian Sea.

been published in modern times. Some of the familiar titles are *The Fox and the Grapes*, *The Wolf and the Lamb*, *The Ass in the Lion's Skin*, *The Lion and the Mouse*, and *The Ox and the Frog*. See FABLE.

AFGHANISTAN, *af gan'i stan*. Although some of the greatest war lords of history—Darius the Great, Alexander the Great, Genghis Kahn, and Tamerlane—have led their conquering hordes through Afghanistan seeking India and riches, not one of them has ever subdued this little country northwest of India. Its nomadic people, some of whom trace their descent from Saul of Israel, are a hardy race. They fight for the love of fighting and for the glory of their God, Allah. They have never been completely vanquished in their fight to retain their identity in the Asiatic world.

Afghanistan is an important Asiatic country, not because of its commerce, wealth, or progress, but because it is a barrier between Siberia and India. Before the revolution in Russia, that country and Great Britain had joint interests around Afghanistan. Afghanistan barred the way to extension of British influence from India as well as to any invasion of India from the north. The country is bordered by Iran, the Uzbek Soviet Republic, Pakistan, and India.

The Durani, by far the largest of these, claim to be descended from King Saul and call themselves Ben-i-Israel, meaning *Children of Israel*. Most of the others are of Turkish, Mongolian, or Persian origin, or are a mixture of races.

Although freedom of worship is permitted, Afghanistan is predominantly Moslem. Persian is widely spoken, but Pashtu is the official language. To wipe out the widespread illiteracy of the past, elementary education is free and compulsory, and schools are being increased. There are also free high schools in a few cities and several institutions of higher learning in Kabul, the capital.

Although there are several other fairly large cities, including Kandahar and Herat, most of the people live in small farming villages. Many others are wandering herds-men or traders. Hard-working and sturdy, the Afghans have always fought for their independence when necessary.

Afghanistan is a plateau crisscrossed by the snow-capped ranges of the Hindu Kush, some of whose peaks are 24,000 feet high. Most of the country is too mountainous or too rocky and dry for farming, but some of its valleys are fertile and well watered, and other of its lowlands are made productive by an increasing number of irrigation projects. Many fruits and nuts grow wild in the valleys, and castor-oil, madder, and asafetida plants abound. The chief crops are vegetables, grains, tobacco, sugar cane, cotton, and melons.

Although horses, camels, yaks, oxen, asses, and goats are raised on the country's native grasslands, Afghanistan is especially noted for its sheep. Its many native fat-tailed sheep not only supply meat, skins, and wool, but also "butter," made from the grease of their tails. From its Karakul sheep come many "Persian" lamb-skins for sale to furriers abroad.

Afghanistan has the world's finest lapis lazuli, some oil, and an abundance of copper, iron ore, chromite, beryl, gold, silver, lead, zinc, asbestos, mica, and coal. The development of its minerals has only

begun, however. Although it produces some timber and resin gums, its extensive forests also remain largely unexploited.

Afghans are noted for their handicrafts, especially their hand-loomed rugs, carpets, and shawls. Although the country's industrialization has barely started, a few small factories make silk, woolen, and cotton goods, sheepskin coats, leather, boots, soap, matches, furniture, arms, and ammunition.

Afghanistan's chief exports are Karakul furs, carpets, fresh and dried fruits, cotton, and wool. Most of these are sent to Pakistan through the famed Khyber Pass, in the south, or to Russia through the Shibar Pass, in the north (see KHYBER PASS). Several other mountain passes serve as gateways, however. Afghanistan has no railways, and so camels, horses, and yaks still provide most of its transportation. Nevertheless, its roads are being improved, and the number of its automobiles and trucks is increasing.

Government. Afghanistan has been a constitutional monarchy since 1921. Its laws are made by a Parliament, consisting of a cabinet-aided king; a Senate whose members he appoints for life; and a popularly elected Assembly. Men over twenty years old may vote.

History. From the days of Alexander the Great down to the 1740's, Afghanistan was ruled by one or another of its more powerful Asiatic neighbors. In 1747, however, a Durani chieftain made it the independent center of a large empire. In 1839 the British, then in control of India, sent in troops to discourage too friendly relations with Russia. During the next forty years Britain and Afghanistan continued to quarrel, but finally the Afghans agreed to lease the Khyber Pass to Britain and to let that country conduct their foreign relations. Finally, after another clash with the British, Afghanistan became a completely free nation in 1921. Despite pressure from both sides, it remained neutral during World Wars I and II. It was admitted to the United Nations in 1946.

The Unconquered Continent— **AFRICA**



AFRICA. This second largest continent is so close to Europe at the Strait of Gibraltar that people on one continent can easily look across at the other. The shortest distance is only eight and one-half miles. At the Isthmus of Suez, Africa is separated from Asia by only the width of the ship canal. In fact, Africa, like Europe, can be considered a giant peninsula of Asia, the largest of the six continents. Africa, however, is very different from its neighbor continents—in its climate and in its people, plants, and animals.

Africa comprises about a fifth of the earth's land area and is the home of about 230,000,000 people. Its total area is about 11,600,000 square miles. It is the land which cradled two of the world's oldest civilizations, those in Egypt and in Carthage. Yet, at the dawn of the nineteenth century, it was still the "Dark Continent" to the rest of the world.

Except for the lower Nile Valley and a few coastal strips, Africa remained a mystery to white men. There were good reasons for the blank spaces which showed on the best maps of the continent in 1800.

Strong natural barriers guarded the secrets of Africa's geography and life. There

were so many hazards between the sea and the interior that stout-hearted explorers turned back, discouraged. First there was the unfriendly coast, regular and steep; it offered few safe harbors. Rivers, the usual easy routes inland, were here impassable; a short distance behind the coast they were blocked by the huge waterfalls which pour off the edge of the African plateau. Mountain ranges, dense jungles, or burning deserts stretched across the path. Savage natives, wild animals, and swarms of disease-carrying insects further increased the difficulties and dangers of exploration.

It was not until the last half of the century that the bold pioneering work of Livingstone, Stanley, and others became generally known in Europe. Then, tales of adventure and sudden riches began to draw soldiers of fortune to this new field of campaign. By that time, men had learned more about penetrating new countries. They had harnessed steam on land and sea. They had perfected their guns and other equipment. They had learned how to protect themselves from many diseases. They had colonized the New World to the west and gained brief respite from European wars. They were ready, at last, for the African frontier.

The Land Astride the Equator. With the exception of Asia, the African continent has a longer north-to-south range than any of the other grand divisions. From Cape Bon on the Mediterranean south to the Cape of Good Hope is about 5,000 miles. From Cape Guardafui on the

Gulf of Aden west to Cape Verde on the Atlantic is close to 4,500 miles. About midway between its northern and southern extremities, Africa is crossed by the equator. Because of the triangular shape of the continent, the part above the equator is larger than that below.

On a trip from Tripoli to Capetown, one goes from a mild south-European climate to the wet heat of the jungle, then finds cool breezes and Riviera weather again farther south, in the country of the Boers. For range of climate, such a trip would be similar to a journey from Baltimore to Buenos Aires. On the African coast of Somaliland, one stands east of most of Europe; on the Atlantic shore, one is west of Ireland.

The surrounding waters are the Mediterranean Sea and the Strait of Gibraltar to the north, the Red Sea, Gulf of Aden, and Indian Ocean to the east, and the Atlantic Ocean to the west and south. There are no coastal indentations of importance with the exception of the big bend which the Gulf of Guinea makes in the west coast and the long, narrow channel of the Red Sea on the east. With an area about three times that of Europe, Africa has a coast line but very little longer, because it is comparatively unbroken by bays, gulfs, or broad estuaries. This lack of shelter for shipping doubtless tended to retard the development of the country for centuries.

The more important islands associated with Africa are Madagascar, fifth largest island in the world; the Madeira, Canary, and Cape Verde groups; and such historic outposts as Saint Helena, Reunion, Ascension, Mauritius, and Zanzibar.

Where Mountains Meet the Sea. The great plateau that is Africa rises sharply from the ocean depths. There is very little of the coastal-plain type of ground on the whole continent. Circling the rim of the plateau, a rough chain of disconnected mountain ranges rises above the high land of the interior. These ranges make a great wall around the northern portion of the

central tableland and draw closer together in its southern wedge, like marbles in the bottom of a bag. The average height of the whole continent is more than 2,000 feet above sea level; the highest point is the summit of Mount Kilimanjaro, in Eastern Africa, 19,700 feet; the lowest, a spot in the Libyan Desert, 400 feet below sea level.

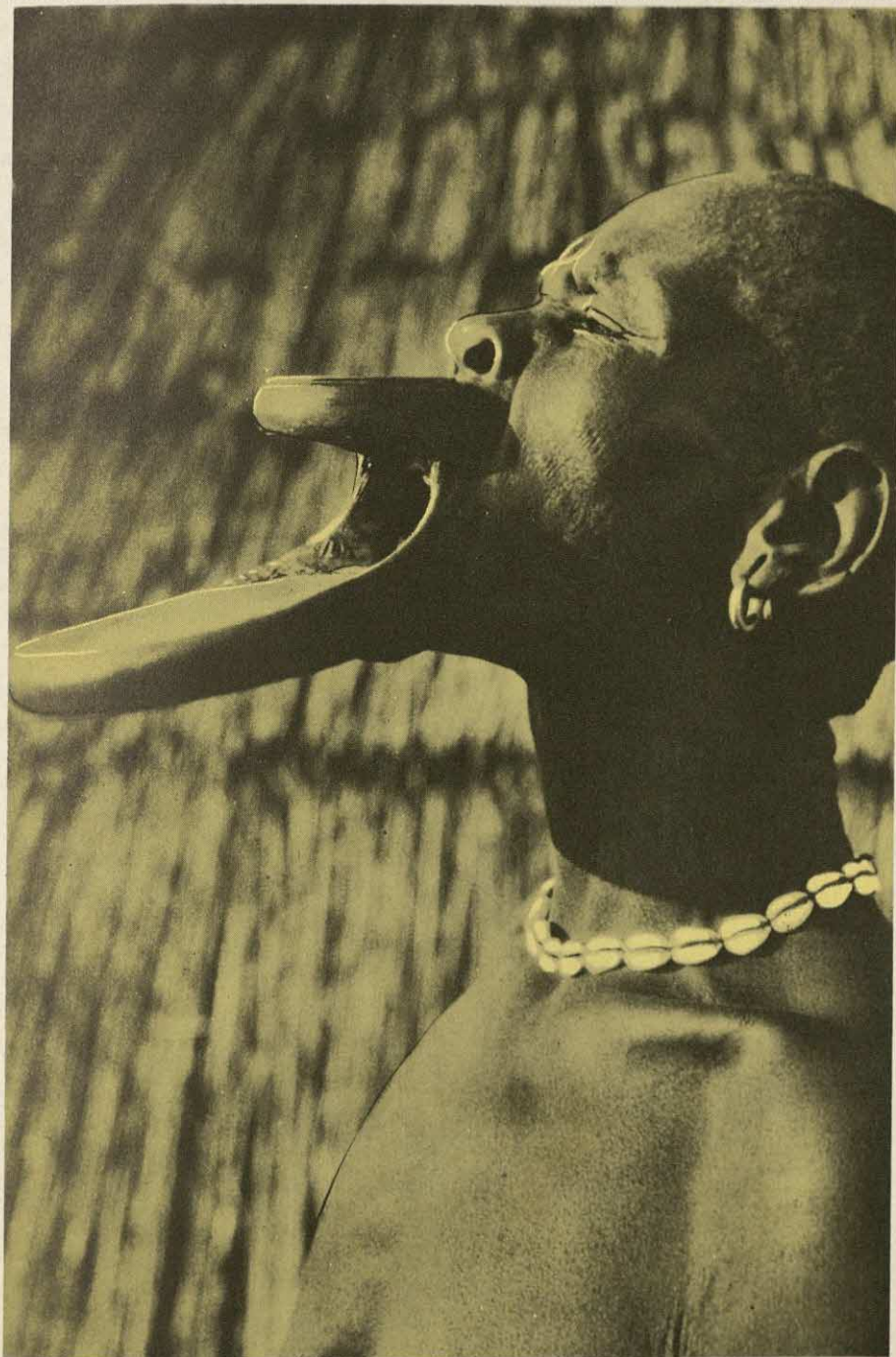
Since the mountain ranges do not arrange themselves into as orderly a pattern for this continent as they do for some other land masses, it is perhaps easiest to study Africa's surface by thinking of it as being in two parts, with the dividing line about five degrees north of the equator. *North Africa* is a big, irregular oval lying on its side; *South Africa* is the wedge below, with its tip to the south.

In general, North Africa is lower than South Africa, but it has an important mountain range, the Atlas, in the western part. This range parallels the north coast. Some of its peaks are higher than 14,000 feet and they rise so steeply from low land to the east that their apparent height is increased. The southern slopes of the Atlas Mountains lead directly into the vast Sahara, the world's largest and most fearsome desert.

A Barrier of Sand and Sun. For a land in which few men or beasts or plants can live, the Sahara has had a strange influence on civilization. For hundreds of years it prevented any extensive trade, in ideas or goods, between the white races of the north and the black of the south.

For the most part, the desert is about 1,200 feet above sea level, although it embraces some mountains as high as 9,000 feet and some places more than a hundred feet below sea level. As might be expected of an area the size of Europe or the United States, it shows considerable variety of surface, but from the Atlantic to the Nile and on into Arabia, from the Mediterranean to the Sudan, the dry Sahara stretches a blanket of desolation. There is no life except at scattered oases.

The Belt of the Sudan. A lower region of plains, hills, and valleys, known



A STRANGE IDEA OF BEAUTY

This woman of a Uganda tribe has stretched her lips enormously, following an ancient "beauty treatment" which is now fast disappearing. Small wooden discs were inserted into holes cut in her lips, and each year a larger disc was used, stretching the lips more and more until they reached this great size.

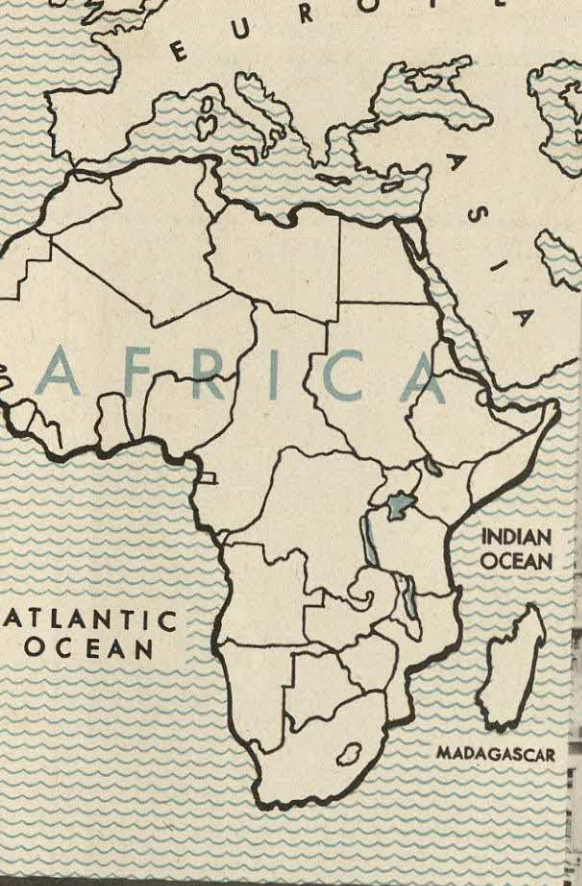


Photo by Deane Dickason; By Burton Holmes, from Ewing Galloway, N.Y.

CONTINENT OF VARIED CULTURES

Modern Africa shows the influence of both Europe and Asia. Egyptians follow the Moslem faith, which came from the East, but Western ways are common in Cairo (below), their capital city. The Voortrekker Memorial (bottom) in Pretoria, capital of the Union of South Africa, honors the heroism of Boer, or Dutch, pioneers.





BUSINESS DISTRICT—AFRICAN STYLE: AN ETHIOPIAN VILLAGE

This is the town of Mendi, a trading post in the Shankalla country. It is the home of some of Africa's most primitive tribesmen. The sheetlike clothes come off during the heat of the day.

as the Sudan, extends from the Sahara south to the Gold Coast and the Gulf of Guinea. Southwest, at the head of the gulf, are the Kamerun (or Cameroon) Mountains, a low range. Another chain of highlands runs from north to south in the eastern part of North Africa, along the Red Sea.

In South Africa, a ridge of highlands extends southward from Ethiopia, reaching impressive heights in the region of the Kenya and Kilimanjaro peaks. This ridge splits up into a number of so-called "Cape folds" south of the equator, forming deep basins for the great lakes, Victoria Nyanza, Albert Nyanza, and Tanganyika.

South of Lake Edward in this territory are the Kirunga Mountains, which separate the lakes that feed the Nile from those that drain into the Congo and Zambezi. Near here also are the beautiful Ruwenzori Mountains, believed to be the "Mountains of the Moon" described by the geographer Ptolemy in the second century. They are nearly 17,000 feet high.

Farther south, these parallel ridges form the Drakenberg Mountains, which reach

heights of 10,000 feet and extend to the southern tip of the continent. The western rim of the great central plateau and the Kalahari Desert is somewhat lower, but still maintains an average altitude of 4,000 feet.

The Mighty Streams and Lakes of Africa. The location and arrangement of the mountains provide Africa with a peculiar system of drainage. The great rivers must take roundabout ways before they tumble over the edge of the plateau and find the sea. In breaking through the mountains, the rivers have formed the falls and rapids which prevent navigation to and from the oceans. Some well-known examples are the cataracts of the Nile, the rapids of the Congo at Leopoldville, and the lofty Victoria Falls of the Zambezi.

Three of the four largest rivers in Africa drain into the Atlantic or its tributary waters: the Congo, 3,000 miles long; the Niger, 2,500 miles long, and the Nile, 4,000 miles long. In volume of water discharged the Congo is one of the world's largest rivers, second only to the Amazon of South America. The Nile made Egypt



UPI

A MODERN SKYLINE RISES IN AN AFRICAN REPUBLIC
Accra, capital of the Gold Coast republic of Ghana, has many fine buildings, including Central Library (center). Ghana was granted independence by the British in 1957. Three years later it became a republic within the British Commonwealth.

the granary of the known world in ancient times and is today the life stream of modern Egypt's agriculture. Both of these rivers take their headwaters from the high land near the equator.

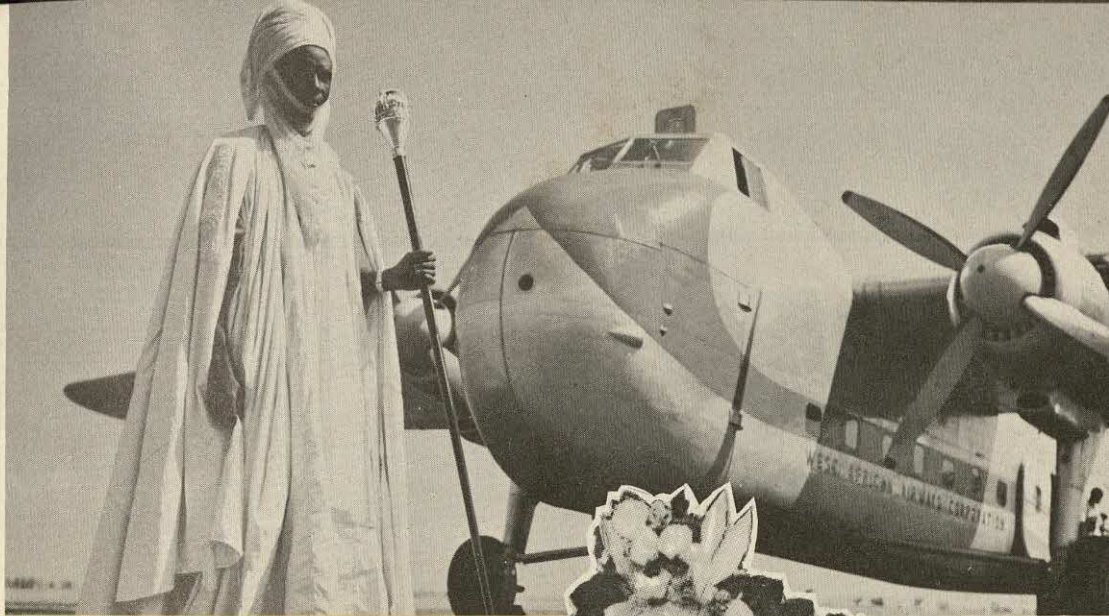
The Niger is a remarkable example of the influence of various high and low lands on the development of a country; it drains a valley 2,500 miles long, yet rises only 150 miles from the sea. Thus the valley is about fifteen times longer than it would be if the river flowed straight to the sea, because it takes a remarkable, back-country excursion trip before it does an "about-face" and empties into the Gulf of Guinea. The Zambezi is the fourth major stream and the only one of great importance draining into the Indian Ocean.

Lower South Africa is drained into the Atlantic by the Orange River and its tributaries, and into the Indian Ocean by the smaller Limpopo. Comparatively unimportant are the Rovuma, Tana, Juba, and Shebeli, all north of the Zambezi. The Senegal, which rises south of the Sahara near the sources of the Niger, is a partially navigable, 1000-mile river emptying into the Atlantic.

No other continent except North America has such large lakes. Victoria Nyanza, reservoir of the Nile, is 180 miles in diameter, and next to Lake Superior is the largest fresh-water lake in the world. Albert is smaller but is still a great inland sea. Edward is about 100 miles long. Lake Tanganyika is like a tremendous river, 20 to 40 miles wide and 400 miles long. When its level is high, it pours a flood of water into the Congo drainage basin.

Deepest of these great lakes is Nyasa, which fills a mountain canyon 350 miles long by 45 miles wide and drains into the Zambezi system. West of Nyasa is Lake Bangweolo, feeding the Congo. A lake that is doomed to disappear before many years is Lake Chad, south of the Sahara, which gets its water from inland drainage, has no outlet, and yet remains fresh. Lake Chad is slowly drying up as the desert advances. Lake Tsana in Ethiopia drains into the Nile.

From Tropics to Temperate Zones.
Due to the fact that the equator crosses the continent almost midway of its length, the temperature gradually lowers from the center, either to the north or the south. Thus the climate is mostly tropical or



Unations

HELPING HAND FROM THE U.N.

The king of Adamawa (above) welcomes an airborne U.N. mission to his land. Right, an ornate Zulu rickshaw boy attracts a fare.

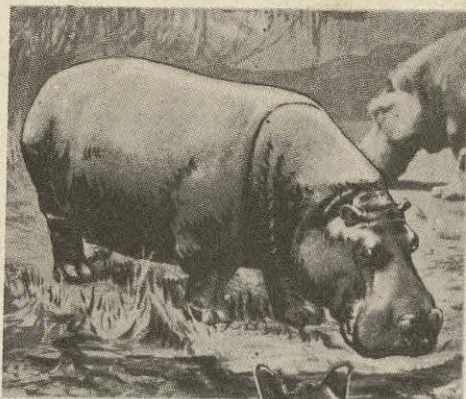
warm temperate.

Along the Mediterranean there is the kind of weather which draws people to the European Riviera. In the Sahara Desert, only the oases offer conditions where living is possible.

In the Sudan, which lies south of the Sahara, the climate is somewhat like that of the United States between the Mississippi River and the Rocky Mountains. There are high plains, fertile valleys, and some forests. The land at the equator is of such altitude that the temperature is cooler than it is 1,400 miles north of it, where lower levels produce typical jungle weather.

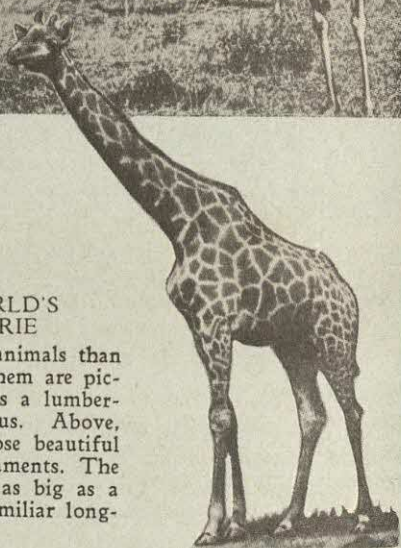
In the next layer, going down to the Congo Basin, there is the climate of the jungle, always wet, always hot. East of the Congo Basin, there are mountains and great lakes which modify the climate. As a usual thing, the higher the land, the lower the temperature. The central plateau in the southern part of Africa is a land of dry valleys, with occasional water holes, where a hardened depression of the earth surface makes a "pan," or place for water to gather.





NATIVES OF THE WORLD'S GREATEST MENAGERIE

Africa has a greater variety of animals than any other continent. Some of them are pictured here. At the upper left is a lumbering, thick-skinned hippopotamus. Above, right, a troop of ostriches, whose beautiful plumes were once fashionable ornaments. The okapi, left, grows to be about as big as a horse. He is a cousin of the familiar long-necked giraffe, right.



The high veldt called the Kalahari Desert is so large that it takes all day to cross it by train. It has enough rainfall in some parts so that a few crops can be raised. The Cape folds give the variable climate associated with mountain territory, and at Cape Town, where the mountains come down to the sea, there is sunny, mild, equable weather like that of Monte Carlo or Los Angeles.

The rainfall in Africa is very uneven in its distribution. At the equator, every month has rainy days, and there are two periods of such steady torrents of rain that they are called rainy seasons. As we travel north or south from this wet center of the continent, there is less and less rain, and there are parts of the Sahara that never get a drop.

The Kalahari tract is called a desert, but there are occasional rains in parts of this area which encourage enough vegeta-

tion to feed grazing herds. Rainfall is influenced by the formation of the land. The mountainous rim of Africa shuts off rain that the clouds would otherwise carry in from the mighty oceans lying on either side of the continent.

Plant Growth in Forest, Plain, and Desert. Plant life is closely linked to rainfall. The people who live along the Mediterranean raise vegetables and grain, and the same sorts of fruit as are found in Southern Europe. These crops are so plentiful that some of them are sold in Europe. The olive trees are profitable, and there are also oak trees. South of this area, the growth of plants and trees rapidly becomes less, and in the Sahara, only the oases, where there are springs of water, show any vegetation.

South of the Sahara is the savanna region, where most of the great plains are covered with grass and shrubs; here there



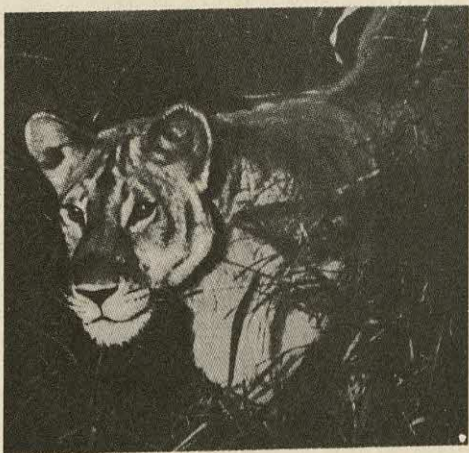
THE LORDLY ELEPHANT

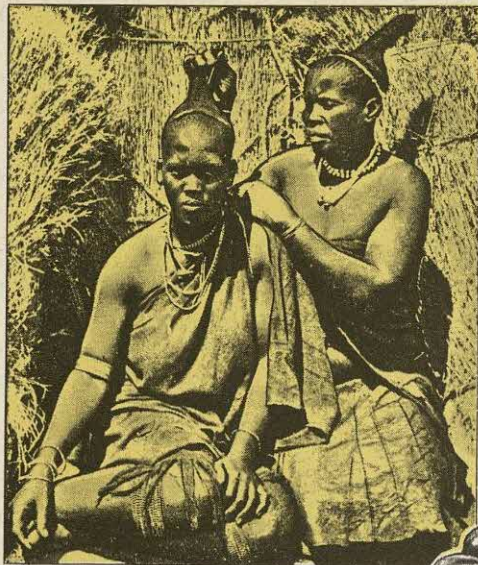
Largest of all land animals. Those shown above are tame. The two-horned antelope at the right is a Beisa oryx. Below is a lioness, huntress of the night.

are some forests. The trees of this section seem small when compared with those of the tropical jungle, which reaches from the Gambia River to the coast, southward nearly to the mouth of the Congo, and eastward almost to Victoria Nyanza. In this vast forest there are many kinds of trees of huge size, growing closely together and matted and looped with fantastic vines and undergrowth to form a gigantic jungle. In area, this jungle is more than half as large as the United States, and the only forests in the world of greater extent are those of the Amazon.

To the south of the jungle, the vegetation is again of the savanna character, with small forests in Ethiopia, in Central Africa, especially near the rise of the Congo, and along the coasts of South Africa. The great wealth in plant products—timber, oils, rubber, and cotton—to be found in Africa is just beginning to be developed.

The World's Greatest Menagerie. The largest animals in the world live in Africa, and also some animals found nowhere else. With no mountains dividing the interior of the country, animals have a wide range, and the same sorts are seen in many different sections. As plant life is related to climate, so animal life is related to plant life. On the grassy plains, or savannas, of the country are great numbers of grass-





A KAFFIR BEAUTY PARLOR
Right, Pygmies of Central Africa.



eating animals, such as the elephant, giraffe, buffalo, rhinoceros, zebra, gnu, and more than fifty kinds of antelope. The giraffe is one of the animals which is native to Africa alone.

Lurking in the forests and heavier vegetation are the meat-eating animals which hunt the grass eaters as food: the lion, leopard, hyena, and panther, and the jackal, which feeds upon the bodies of animals killed by the bolder beasts. There are no tigers, wolves, or bears.

As the animals hunt each other, so man hunts the animals—for meat, for fur, and for ivory. The elephants have been so lavishly killed for ivory that they are now few, compared to the vast herds of earlier times. The rivers and swamps are alive with hippopotami and crocodiles, monkeys and snakes are numerous throughout the country, and in the jungle, too dense even for most of the animals, are the huge serpents, boa and python, and the manlike gorilla and chimpanzee.

Africa is the home of many strange and

beautiful birds. These are notable for brilliant plumage and odd habits, but there are few song birds. There are the ibis, quail, weaver bird, secretary bird, parrot, guinea fowl, wax bill, and the ostrich, which like the giraffe is native to Africa.

The horse has queer cousins in Africa: the zebra, with its gay stripes, the tiny ass of Mauretania, the quagga, and the camel, or "ship of the desert."

The continent teems with insect life, much of it so pestiferous that it is an additional reason for the lag in the development of the country. Locusts devour crops, termites destroy buildings, the bite of the tsetse fly is fatal to many animals, and through all the land the hordes of mosquitoes buzz, swarm, and sting.

Butterflies are seen in large numbers and great variety. They hang like living jewels on leaf and flower, or display their vivid coloring in graceful flight.

Buried Treasure. The mineral wealth of Africa has been only slightly developed, though already figured in billions of money, and much of the probable rich deposits have not even been explored. This is especially true of coal and iron. While diamonds and gold are first in thought, and have been foremost in production, it is possible that the deposits of tin, copper, lead, zinc, antimony, manganese, and mercury will prove far more valuable.

Johannesburg, in the Transvaal, is the center of the gold-mining industry, and now exceeds the United States in production of this romantic commodity. Kimberley mines and exports nine tenths of the world supply of diamonds.

Petroleum, so necessary to transportation, is also found in the northern part of Africa, and the Belgian Congo and South Africa are richly supplied with pitchblende, source of radium and uranium.

A Carnival of Races. Even the rare travelers of ancient times remarked on the great variety of the races peopling

Africa. This variety is more marked in modern times, after hundreds of years of migration and conquest have changed the African scene. Colonization by the white man has increased the racial mix-up and has brought old and new modes of life into sharp contrast.

The historic home of the white race has been Northern Africa, of the black, Central and Southern Africa; but time has so mingled the many strains that it is no longer possible to draw clear lines between the groups. In the Sudan, for instance, the people are of mixed stock.

Broadly considered, there are four great native races: the Semites of the northwest and the Hamites of the northeast, both white; and the Negroes and Hottentots of the equator and the south. The Bantu branch of the Negro race is very widespread and includes most of the tribes found from the Sudan south almost to the Cape. Bantus may differ widely in size and color, but they all speak related languages.

The Hottentots are probably another branch of the Negro race, but are enough different to be put in a class by themselves; they are native to the Cape highlands. Blackest of the Negroes are the Sudanese, and it was among them that the slave traders sought their prey for more than three hundred years. Millions were seized and transported to labor in foreign lands.

About four fifths of Africa's people are Negroid. Of the rest, only some 3,000,000 are whites, chiefly of European origin.

Many of the tribes are well known in other lands, as they have figured in stories of African wars and adventure. Riffs, Berbers, Tuaregs, Arabs, Egyptians, and Ethiopians in the north, Zulus, Bushmen, Pygmies, Somalis, and Masai in the south and east—all are typical dwellers of this strange land.

Semites and Hamites find a point of union in their Mohammedan religion, and followers of this faith are said to account for a third of the population. Negro



B.O.A.C.

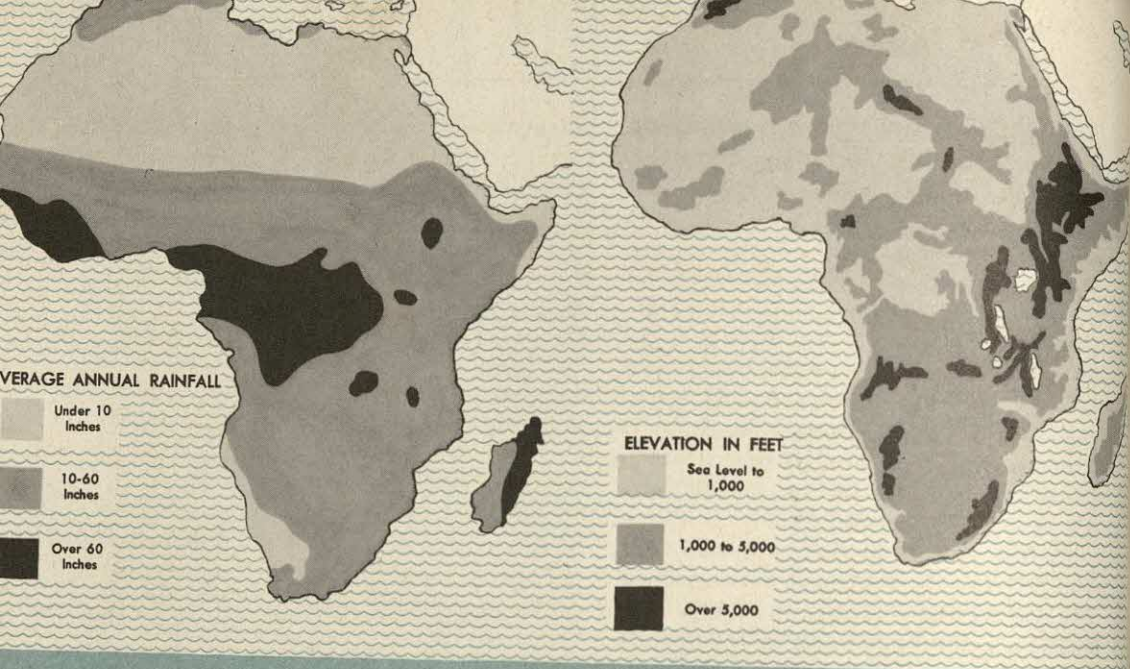
BEAD-MAKER IN SUDAN REPUBLIC

Turbaned Moslem in Omdurman makes beads on his primitive lathe, operated by hand and foot.

tribes cling to barbaric worship in their own tradition.

The manner in which all these different types of people gain a living depends largely on the climate and resources of the regions in which the group resides. It may be hunting or herding, toiling on the great plantations, or digging in the mines. Nature itself largely determines how and where the people live.

The White Man Moves into the "Dark Continent." Civilization was well established in Africa long before the Roman Empire was founded. Several great cities flourished along the Mediterranean coast, from Egypt to Carthage, but because of the difficulty of travel, either by land or sea, they had very little to do with the rest of the great continent to the south. The upper Nile Valley probably led a few Egyptians or wandering Arabs to push on south into the Sudan and the great-lakes



THE HIGHS AND LOWS OF THE AFRICAN CONTINENT

The Sahara Desert and the tropical rain forests are easily located on the map at left. The map at right shows Africa's scattered mountain ranges and the high plains of South Africa.

region. No one, however, seems to have made any real effort to settle and develop the interior until the nineteenth century.

The Arabs came into the north in the Middle Ages, but did not migrate beyond the desert. In the fifteenth century, several voyages of discovery were made along the coasts, and the Portuguese even started colonies along their ocean routes. Diaz finally rounded the Cape of Good Hope in 1487, and Da Gama, following the same course, sailed on to India some ten years later. These events, important as they were, did not arouse a great deal of interest among Europeans who were too busy with their own affairs to think about Africa.

From 1795 to 1797, Mungo Park made his famous expedition through the Niger country and began the modern era of African exploration. David Livingstone took up the work in 1840, moving from Cape Town toward the equator, and by the time he died, in 1873, he had explored a vast area to as far north as the head of Lake Tanganyika. He was followed by the Anglo-American newspaper man,

Henry M. Stanley, who investigated the districts around the headwaters of the Nile and traced the course of the Congo River to its mouth at the Atlantic.

How the Continent Was Divided. The breaking up of Africa into colonies of the great powers of Europe took place in the 1800's. The British took possession of South Africa from the Dutch between 1795 and 1814. The Dutch had been there from 1652. France took control of Algeria by 1847, and Tunisia in 1881. The British started ruling Egypt in 1882.

In 1876, Leopold II of Belgium engaged Stanley the explorer for greater exploration of the Congo region in order to found a Belgian colony. France, Great Britain, and Germany also began to push their claims in West Africa. Chancellor Bismarck of Germany called a conference of the great powers in Berlin in 1884-1885 to consider how Africa should be divided. Great Britain, France, Belgium, Portugal, Spain, Germany, and Italy then began to take huge slices of African territory. Germany lost its African colonies after World War I. Italy lost its colonies after World War II; North

Africa was a World War II battleground.

After World War II, many Africans wanted national independence, all wanted equal treatment with Europeans, and some wanted them to get out completely. Great Britain and France educated the people for leadership and gave them more self-government.

Political Divisions. At the end of World War II, there were three independent nations in Africa: *Liberia*, established in 1847; the *Union of South Africa*, a nation within the British Commonwealth since 1910; and *Egypt*, independent of Great Britain since 1922. The following paragraphs name the nations that have gained independence since then. Many of them although fully independent, have chosen to stay within the British Commonwealth of Nations or French Community system for the purpose of trade advantages or economic aid. See **BRITISH COMMONWEALTH OF NATIONS**. Dates, given below, unless otherwise explained, are dates of attaining independence.

North Africa: Libya (1952), former Italian colony and United Nations trusteeship. Morocco (1956), former part of France. Spanish Morocco was added to it in 1958. Sudan (1956), formerly ruled by Great Britain and Egypt. Tunisia (1957), former part of France. In French Algeria, a bloody war for independence began in 1954. France in 1959 offered independence to Algeria in four years. In 1958, Egypt joined with Syria to form the United Arab Republic.

West and Central Africa: In 1957 Ghana became a self-governing member of the British Commonwealth and in 1960 a republic in it. In 1958, Mauritania, Senegal, Sudanese Republic, Ivory Coast, Volta, Niger, Dahomey, Chad, Republic of the Congo, Central African Republic, and Gabon became self-governing members of the French Community; in 1960 they became republics within the Community. Guinea (1958), former French Guinea, left the French Community. Togo (1960), former French trusteeship of Togoland. Cameroon Republic (1960), former French trusteeship of Cameroons. Nigeria (1960), former part

of Great Britain, now member of the British Commonwealth. Congo Republic (1960), former colony of Belgium. Areas still under foreign control: Spanish Sahara and Spanish Guinea, Sierra Leone and Gambia (both British), Portuguese Guinea, and the British trusteeship of Cameroons.

South Africa: The Malagasy Republic on the island of Madagascar became self-governing in 1958 and a republic in the French Community in 1960. Territories still under foreign control: Angola and Mozambique (Portugal), Bechuanaland, Basutoland, Swaziland (Great Britain), Southwest Africa (Union of South Africa), Réunion (France). The Federation of Rhodesia and Nyasaland (British) has some self-government.

East Africa: Ethiopia (1947), an independent nation conquered by Italy in 1935. Eritrea, former Italian colony and British U.N. trusteeship, federated with it in 1952. Somali Republic (1950), formed by union of former Italian and British Somalilands. Areas of East Africa under foreign control: Kenya, Uganda, Zanzibar (Great Britain), French Somaliland. Tanganyika is a British trusteeship, and Ruanda-Urundi, a trusteeship of Belgium. Independence was being planned for Tanganyika, Kenya, and Uganda.

Further information is given in the articles on Africa's political divisions and islands and on many of its animals, plants, and products. Also see:

Arabs	Moors
Assuan	Negro
Atlas Mountains	Niger
Bantu	Nile
Barbary	Nyasa
Bedouins	Pygmies
Berber	Red Sea
Boer	Rhodes, Cecil John
Bushmen	Sahara
Cape of Good Hope	Senegal
Cape-to-Cairo Railway	Sinai
Carthage	South African War
Chad, Lake	Stanley, Henry M.
Congo River	Suez Canal
Dias, Bartholomew	Tanganyika
Hottentots	Victoria Falls
Kaffirs	Victoria Nyanza
Kalahari Desert	World War (I, II)
Kitchener, Horatio H.	Zambezi
Livingstone, David	Zulus

AGASSIZ, *ag'ah se*, JEAN LOUIS RODOLPHE (1807-1873). Though he was born in Switzerland, this great naturalist spent nearly half of his life in the United States as a teacher and lecturer, and to this day, American teachers of natural history are following the methods he introduced. He had his classes study animals and plants in the open, for he believed that one should learn the facts of natural history from observing nature, not from reading textbooks.

Agassiz was born near Lake Neuchâtel, Switzerland. His father, a Protestant minister, gave him an excellent education, and he was a student at such first-class universities as Zurich, Heidelberg, and Munich. While studying medicine at Munich, Agassiz was asked to make a classification of the fishes of Brazil, as the naturalists who had brought back a large collection were unable to complete their work. His classification of the Brazilian fishes led him to the study of fossil forms, and he later became a specialist in geology.

From 1832 to 1846, Agassiz was professor of natural history at the University of Neuchâtel; during this period he made a thorough study of the glaciers of Switzerland, and in 1840 he published a book proving the widespread distribution of great ice sheets.

Agassiz began lecturing in America in 1846, and in 1848 he became professor of zoölogy at Harvard University. He was an inspiring teacher and his ideals were carried into classrooms throughout the country. The Agassiz Museum of Natural History at Harvard was founded by him in 1859, and he established a summer school off the Massachusetts coast on Penikese Island, in Buzzard's Bay, a few months before he died. This school became the model for similar schools devoted to zoölogical research. Agassiz was buried in Mount Auburn Cemetery, Cambridge.

AG'ATE. A kind of layered quartz, agate is stone that is as hard as steel. It takes a high polish and in natural or artificially stained colors is valued for

ornaments and jewelry. Mortars in which chemists crush hard substances and the fine "knife-edges" on which laboratory balances are supported are made of agate, because the quartz is little affected by moisture or fumes. Agates may vary in color from pure white to jet black, although shades of red are common. The colors may be arranged in bands, or so blended as to give the mineral a mosslike appearance. Agates are found in many places, the commercial supply coming largely from Uruguay, Brazil, India, and Northern North America. See QUARTZ; PRECIOUS STONES.

AGE OF MAN, or HUMAN PERIOD.

Compared to the age of the earth, man's life on it has been short. This period of human existence is known as the Age of Man.

What little knowledge has been gleaned of man's origin and development comes from the earth's only diary—its crust of layered rock. Buried in some of these layers are skeleton remains of plants and animals that lived hundreds of thousands of years ago. When these fossils come to light, the age of the surrounding rock tells about how long ago they lived. The lower, older rock layers reveal that plant life and animal life were in full swing millions of years before the first men came upon the scene.

It used to be argued that man could not have been on earth before the time, some 20,000 years ago, when the last of the Glacial Period ice sheets which covered the land began to melt away. But when stone tools, very evidently made by men, were discovered in rock formations 100,000 years old, ideas about the antiquity of human life had to be enlarged. This discovery, in the last century, led to a search for other fossil deposits in many parts of the world. Several were found, in rock that had been old before the glaciers! They indicated that manlike creatures who made rough implements were living hundreds of thousands of years ago — much earlier than was formerly supposed.



HOME, TRIUMPHANT, FROM A STONE AGE CHASE

Rude hunters display their kill to stay-at-homes of the cave community.

Fossil skulls from these ancient times have enabled experts to reconstruct the features of early man and show the world a being who was just beginning to develop the habits and skills of his present-day cousins. A cranium found in Java has been identified with an apeman who walked upright but had too small a brain to be called human. The Peking man, whose fossil skull was dug up in China, and the Piltdown man, found in England, show larger brains and closer kinship to modern man.

Even when fossil deposits yield no remains of living things, the growth of civilization can be readily traced through the ascending quality of the crude utensils left by early man. These show his progress through the ages of stone and bronze and iron. From the first knives of chipped flint to the polished and decorated implements of later centuries, his gradual improvement in hunting, farming, and homemaking can be seen. His striving to develop industry, art, and writing are apparent in the relics held by each succeeding rocky level which outlines the Age of Man. See GEOLOGY; STONE AGE; BRONZE AGE; IRON AGE; ANTHROPOLOGY.

AGOUTI, *a goo'te*. Among the animals unknown to people in northern countries is the agouti, found only in South America and the West Indies. It is a gnawing animal, or rodent, and is about the size of a rabbit. The agouti grunts like a pig and lives in a hole burrowed in the ground, or in a hollow stump. It sleeps by day, but at night it goes prowling about in search of food, feeding greedily on fruit, vegetables, and sugar cane. The natives kill it for its flesh.

AGRICOLA, *a grik' o lah*, GNAEUS JULIUS (37-93). This able Roman general was the first of twelve governors to succeed in bringing the colony of Britain (England) under the Roman rule. He not only subdued the rebellious Britons, but governed them wisely during his administration of seven years (77-84). Agricola built a series of forts between the firths of Forth and Clyde, as a barrier of defense against the warlike Caledonians of Scotland. In a voyage around Britain and Scotland, he discovered the Orkney Islands, to the north. Tacitus, son-in-law of Agricola, wrote a story of the general's life which contains interesting facts about Britain under the Romans.

The BASIS of CIVILIZATION



AGRICULTURE. The story of agriculture begins before the time of written history, and as long as mankind exists, so long will agriculture be practiced. The Latin language gave us the name, for it comes from *agri* (genitive), meaning "of the field," and *cultura*, meaning "tillage." The following article shows how tilling the land brought about the preservation of the human race and made possible the growth of civilization the world over.

The Foundation of Civilization. No matter how far man has come from the days when he lived in a cave, he still must depend on the soil. Every civilization he has built has been rooted in the land; all progress and prosperity are based on it, and every other industry, directly or indirectly, is bound to the soil.

Agriculture feeds and clothes the world. From the harvest fields and the garden, from cattle, sheep, hogs, and poultry, come the foods that keep man alive; from the wool and hide of animals, from the fibers of cotton and other plants, are his principal garments made. In addition to furnishing the basic necessities of humanity, agriculture is branching out to the industrial world. Its products are being used for building materials, in the making of automobiles, in chemicals, radio, fuel, and oil. Instead of becoming less necessary to civilization, agriculture is becoming more important.

Agriculture is the only pursuit of man-

kind that really creates, for it alone produces raw material, while other industries merely transform matter. It gives more work than any other field of endeavor, and even though a smaller portion of the people till the soil than in former years, farmers still outnumber any other type of worker.

The First Farmers. Thousands of years ago, before history began, men did not till the soil. They were hunters who ate the animals they killed, and the grasses, grains, fruits, and mosses they found growing wild. They truly did not know where their next meal was coming from, and they frequently starved to death—for often there was no food.

After many centuries, men found that they could grow their own grain. This early agriculture was not much different from that practiced in some primitive and savage lands today. The men used crooked, sharpened sticks for a plow. The women harvested the grain with stone knives and wooden sickles. The men who became farmers were always at war with the men who still hunted and roamed the land.

Out of this early farming grew the civilizations of Egypt and Mesopotamia. These people had ideal conditions for growing grain. In Egypt, the Nile overflowed each spring, leaving the land caked with a fertile soil called silt. In Mesopotamia, the land between the Tigris and



TOOLS THAT TILLED THE SOIL FOR SIXTY CENTURIES

Even today, primitive plows of wood still turn the earth in many lands.

the Euphrates rivers also was flooded every year, leaving fresh soil on top. Slaves tilled the fields with wooden plows. Grain was sown by hand and trampled into the ground by foot. Wheat and barley were the principal crops, and beans, peas, lettuce, radishes, cucumbers, onions, grapes, clover, and flax were also grown. The grain was harvested with a short sickle, winnowed in the wind, and sifted by women.

The Egyptians and Mesopotamians learned how to irrigate dry lands by building lakes to store water, and canals to transport it to the fields. They also learned how to store their grain in buildings called granaries. But these people did not improve their way of farming. They had rich soil; they did not need machinery because they had many slaves, and the landowners did no work.



RICE FOR ASIA'S MILLIONS

The "Staff of Life" for one-third of the world's peoples, rice is grown in the Orient in huge quantities, on flooded fields called *paddies*.

In Greece and Rome. When civilization crossed the Mediterranean Sea to Greece, new methods had to be developed. The Greeks had no kind rivers like the Nile, the Tigris, and the Euphrates, which provided new soil every year. When the Greek farmers found that the soil became poor after the same kind of crops were grown every year, they began to vary the crops. They raised cattle, horses, mules, pigs, sheep, geese, and bees, as well as wheat and barley.

As the country developed more land was needed. The Greeks learned how to grow crops on hillsides, by terracing the land. They drained marshy land and swamps, and irrigated dry soil. They cleared stony ground and mixed different soils together, on which more food could be grown to feed the increasing number of people. But still all these improvements were not enough to supply the increasing demand, and to meet that need, Greece had to establish colonies in the countries she had conquered.

The Romans became the first scientific farmers. Under their second king, Numa Pompilius (714-672 B.C.), small farms were given to the people so that they could raise their own food, and sell it to

the city dwellers. But, as the nation grew into an empire, the small farms were swallowed up by the large ones, and rich landowners took them over. Rome secured enough food for her own people from the colonies in Egypt and Sicily, where there was slave labor, and the land in Italy was given over to raising sheep.

But the Romans learned how to use fertilizers, and how to plant crops like beans, clover, and peas, which would give strength to the soil. This practice of "saving the soil" is still common in modern agriculture. Despite their knowledge, neither the Greeks nor the Romans improved the tools for farming. They used wooden plows and sickles. Slaves, who cared nothing for the farms, and poor tools were the cause of very low yields for the Roman farmers.

A Period of Decline. After Rome fell, agriculture, like other human activities, entered the Dark Ages. People throughout Europe were afraid of the barbarians who roamed the country, and the weaker men sold their freedom to save their lives. Thus the stronger men became barons, and the weaker ones became peasants. The latter tilled the land for the barons, and were given plots of their own, but tools

were poor, the people were ignorant, and the land was wasted. It was the peasants who suffered.

Then, in the fourteenth century, came the terrible Black Death. The peasants flocked to the cities where they could find work. Men asked more money to farm the lands of the barons. In England the lords fenced off their fields and raised sheep because it took less men than it did for growing grain. Farmers began to make money, but taxes were so heavy that they could not save enough to improve their farms. Some farmers paid rent, becoming tenant farmers, another practice that is still common throughout the world.

These conditions existed in Europe for many years, and it remained for America to make the major advances in agriculture. The great farm regions of the world are: the United States and Canada, the plain of Russia, China, the Argentine, South Africa, India, and Australia. Of these, the North American area has had the best opportunity to develop along modern agricultural lines.

North America, Land of Plenty. The great variety of soil and climate on this large continent produces many different foods and agricultural products. Vast grain-growing regions extend from the Texas Panhandle through the Canadian prairie. Across the southern part of the United States is the Cotton Belt. Major fruit pro-

ducing areas are found in many parts of the continent, especially the Northeast (Maine and Nova Scotia, for example), the Northwest, the West, the Rio Grande valley, the southern states, and New York. Dairy and beef cattle, hogs, and sheep are the major livestock. The largest grazing lands for cattle are in the Southwest, for sheep in the Northwest. The Middle West leads in hog raising.

Corn is the largest grain crop of the United States, which leads in corn production. Wheat is the principal grain crop of Canada. Climate and soil are ideal for growing wheat in the vast prairies of Canada, and in central and northwest United States, and these two nations lead the world in wheat production. Other grains yielded in abundance are rye, oats, barley, and millet. Cotton, tobacco, rice, and indigo are principal crops of the Southern States. Apples are grown in many parts of the continent, the type of apple varying with the climate. Among the states and provinces famous for apple raising are Nova Scotia, Maine, Washington, Oregon, and British Columbia. Peaches, pears, cherries, and other fruits are grown. Famous for peaches are Georgia, the Carolinas, and the Great Lakes Region. New York, California, and the shores of Lake Michigan are known for their vineyards, although grapes are grown in other parts of the North American continent. Potatoes are an important crop



Mighty tractors and efficient farm machines are fast replacing these ancient harvest tools.

in both Canada and the United States. California, Florida, Texas, and other warm climate states produce fine citrus fruits of many kinds, and these states and others furnish berries and vegetables that fill the markets of the continent with garden-fresh produce the year around. In fact, America produces a greater variety of crops and livestock than almost any area of the world.

Farmers and Farm Implements. The first farmers in North America were from the British Isles, France, and Holland. Then came Germans, Swedes, and Danes, and, later, settlers, from southern Europe. All of the early farmers brought their own ideas and methods, and they usually settled where soil and climate were most like those of their homelands.

Farms and farming vary with climate and soil, from the small, New England farm that provides only enough for one family, to the great farms and ranches of the middle and western regions. For those early farmers on small, rocky plots, the centuries-old implements still in use in the early 1800's may not have been a serious limitation, but for those who saw the promise of the prairies, better implements were a necessity. The old wooden plow and harrow, the hoe, spade, sickle, and flail would not do. So the iron plow and the grain cradle came into use. In 1831 Cyrus McCormick invented the reaper. Then came the prairie-breaking plow. As the frontier of the continent moved westward, agriculture made greater progress in a few decades than it had in centuries before. As more and better machinery was developed, one man could do the work of many in the "broad, green fields that nourish our land."

Men left the farms and went to live in cities. More people in cities meant more

food was needed, and the farms had to produce more. With the growth of commerce and the building of railroads, industry developed, and these owed their being to the growth of agriculture.

Corn, the Leader. Settlers learned from the Indians how to raise corn, and it was in North America that corn was first raised. Other people, back to ancient times, had spoken of corn, but they meant wheat, or another principal grain of the country. The corn of today is the maize of the Indians. It is grown almost everywhere, but the greatest production is in Iowa, Illinois, Missouri, Indiana, Michigan, Ohio, Minnesota, Kansas, and Nebraska. See CORN.

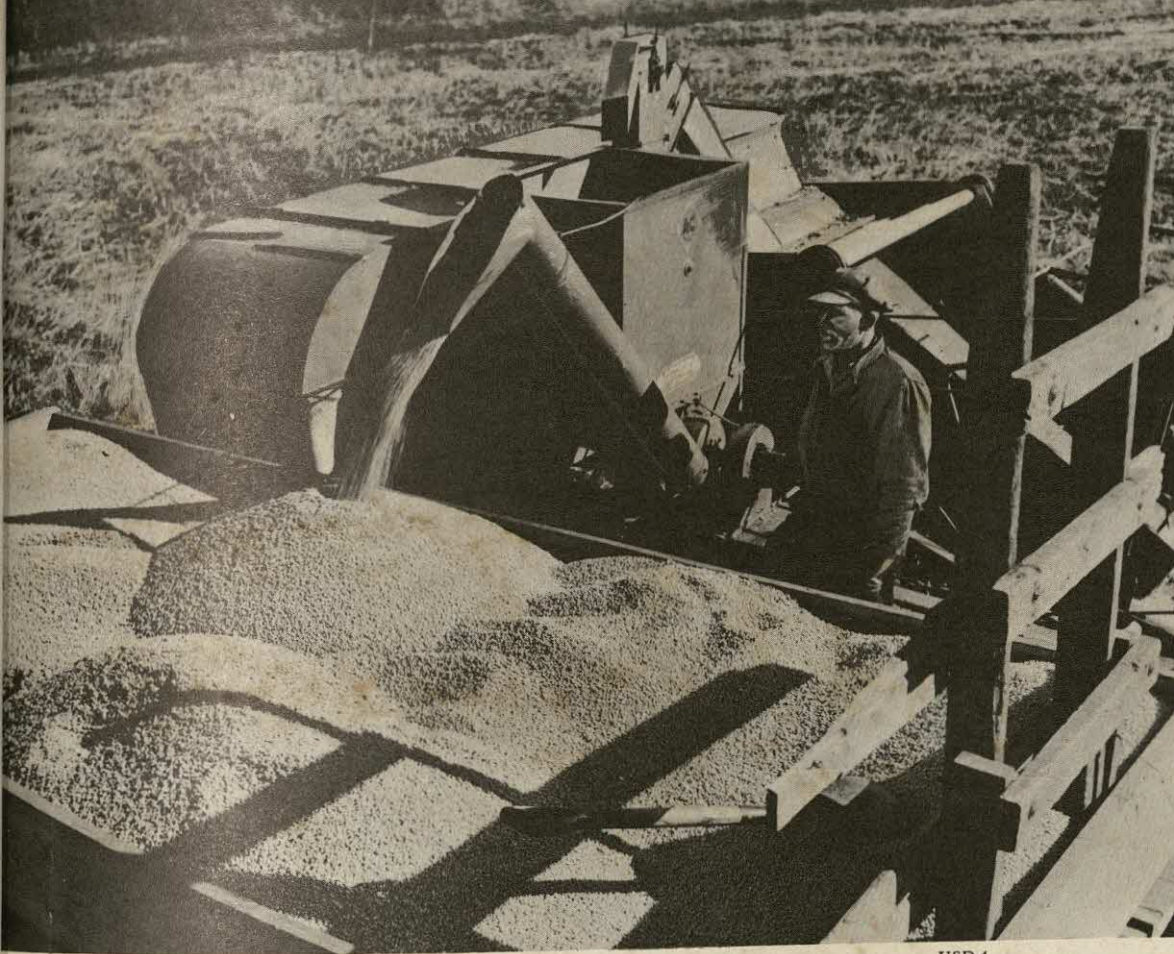
"The Staff of Life."

Wheat has been known to man since he first scratched the soil and planted seed. It has been found in the Pyramids of Egypt and in the ruins of Rome. It is the world's chief grain for breadmaking, and is grown in all parts of the earth except the regions of extreme

heat and cold. There is a harvest somewhere in the world almost every month of the year. Argentina, New Zealand, and Chile harvest their wheat crop in January; Upper Egypt and East India gather theirs in February. In April the wheat threshers are at work in Lower Egypt, Asia Minor, Cuba, Mexico, India, Syria, Cyprus, and Iran. Algeria, Central Asia, China, Japan, Morocco, and Texas harvest wheat in May. June, July, and August are harvest time in the northern United States; September and October, in Canada, Scotland, the Scandinavian countries, and northern Russia. In South America, Australia, and South Africa, wheat is harvested in November and December. In parts of China, wheat is the leading food crop.



Elevators protect grain until it is shipped or processed.



USDA

EAST MEETS WEST ON AMERICAN FARMS

The soybean, imported from China, has become one of the leading crops in the U.S.

King Cotton. In the South, cotton has always been the chief crop since colonial days. Before the Revolution, there was very little cotton grown in the colonies. Tobacco, rice, and indigo were the main crops, and cotton was only a garden plant. But in 1786 a good type of cotton was introduced, and planters began to raise it. Their indigo market had failed, and the great factories of England cried out for cotton to make cloth.

Gradually, the South came to raise only cotton, tobacco, and rice as chief commercial crops. In 1793, when Eli Whitney invented his cotton gin, cotton became even more profitable since it was easier then to clean. Slave labor was employed in the cotton fields, and this fact was a contributing

cause of the Civil War. While the dispute based on slavery increased in bitterness, the owners of the cotton plantations grew more and more of the plant. They exhausted their soil; they took no pains to use scientific methods of farming, and the whole fortunes of the Southern landowners came to depend on the cotton crop.

During the Civil War, cotton production practically stopped. When the war was over and there were no more slaves, the South had to devise new methods. Owners and men who worked the fields began to share the produce of the fields—a method called *share-cropping*. Tenant farming was introduced, and the great plantations were divided into small farms.

In course of time, the cotton growers



Great Northern Railway Photo

THE BOUNTY OF THE GOOD EARTH

Long lines of fat shocks stretch across a wheat field in the Red River Valley.

began to use scientific methods, and many persons in the South turned to industry instead of agriculture. The growing of sugar cane increased, and cattle and hog raising became important agricultural activities. The result was that the South was no longer dependent solely on "King Cotton," as a Southern Congressman once described it, but became a section of diversified activities.

Agriculture of the Plains. When the pioneering settlers came to the Middle West, they brought cattle with them, but they found that the prairie grass for grazing frequently dried up in the summer, and then their cattle would starve. In 1864 it was discovered that the hardy bunch grass of the Western plains could be eaten by cattle.

Then came the era of the cowboy. Huge herds of Shorthorn cattle in Texas and the Southwest were raised and herded to Saint Joseph, Mo., and to other cities in Missouri and Kansas for shipment to the East. Sheep raising in Montana and the Northwest became a rival of cattle raising, and the fights between the cattle and sheep men became known throughout the land. The old "Wild West" has passed, along with the frontier, but its livestock

remains a major agricultural product.

Agriculture's Other Domains. Besides the growing of grain, cotton, and animals to furnish our main food and clothing, agriculture has many other branches. One of the most important is the dairy industry. Holstein, Jersey, Guernsey, and many other breeds of cattle have been selectively bred in the United States for the production of milk. From them come cheese, butter, and cream, and many farms in the country are devoted to this form of agriculture. Fruit raising in Michigan, New York, Florida, California, and Texas has grown to huge proportions, for with the refrigerator railroad car, it is possible to ship and market fruit all over the country.

The growing of vegetables has been brought to a high degree of efficiency, and large numbers of truck farms are supplying the American market. Rice, tobacco, beet and cane sugar, hay crops, nuts, and minor textile plants all have their place in American agriculture. Our census reports show the importance, too, of horse and mule raising, hog farming, poultry farming, and beekeeping.

Farm Markets. Farmers must sell their produce, and people must have food.



*U.S.D.A. Soil Conservation Service;
Massie — Missouri Resources Div.;
Standard Oil Co. (N.J.)*

SCIENCE AND MACHINERY

Erosion (top left) can be avoided by terracing and contour plowing (top right). Self-propelled combines (right and below) boost production while saving time and labor.



Markets are the necessary link. These markets are located in every agricultural region. To enable the farmer to move his goods to market faster, roads from farms to cities and towns have been built, and trucks and railroads carry the produce. In the market, the foods usually go through the hands of a "middleman," who may be in Chicago, or New York, or some other large city.

Markets decide whether the farmer makes a good living or not. When there is a demand for his goods, the price goes up; when the demand goes down and the supply is greater, the price goes down. Foreign countries may sometimes buy the farmer's goods, but not always, for they are always looking for the cheapest grains and meats, and more countries than ever are selling farm products.

More and more the government has tried to safeguard the farmer against the risks of a changing market. Various agencies promote his security and a stable economy by offering long-term loans at low interest rates, by insuring crops against storms and droughts, and by buying crop surpluses.

England, France, and Germany are some of the nations that, in normal times, buy millions of bushels of grain from other countries every year. The United States, Argentina, Australia, and Canada are great exporting countries, selling farm products to the world. But each of these has to buy other products which they do not raise. For instance, the United States must buy coffee from Brazil, sugar from Cuba, and spices from India and other tropical countries. In order to pay for these imports, the nation must sell some of the products of American farmers. This interchange of produce is carried on in commodity exchanges located in certain large cities.

One of the most interesting food exchanges in the world is the Board of Trade in Chicago. There, wheat, corn, and other grains from all over the world are bought and sold. The price is controlled by the demand, by the supply, and also by

commission houses and traders who buy and sell grains for the purpose of making money. Chicago also is a great livestock market. Cattle, hogs, and sheep are brought there to be butchered and readied for shipment to the rest of the world. Chicago, Kansas City, Mo., and Omaha have the huge meat-packing houses of the nation.

New Ways for Old. In the history of agriculture, we have seen that for hundreds of years man made little progress in farming, and that not until the nineteenth century were great strides made. The invention of the iron plow, the cotton gin, the steel prairie plow, and the reaper, all have had a great effect on the progress of the farmer. But progress has not stopped. New ways of getting the most out of the soil, and new uses for crops are being studied all the time. In recent years, the Federal government has adopted new regulations for building up the soil and establishing a better price for the farmers. These are administered through the Department of Agriculture. New inventions may change the whole future of agriculture; an example affecting cotton growers is the automatic cotton-picker recently invented by the Rust brothers. It can pick much more cotton in a day than many pairs of human hands.

In 1857, the first college devoted to the study of agriculture was founded at East Lansing, Mich. It was named the Michigan Agricultural College, and is known today as the Michigan State College. In 1862, during the Civil War, a law was passed by Congress granting each state 30,000 acres of public land for each Congressman. The state was to sell this land, and the proceeds were to be used for colleges of agriculture and mechanical arts. This act gave rise to great agricultural schools. Experiment stations connected with these institutions are maintained by the states and the Federal government.

What is the purpose of these schools and stations? It is to improve man's use of the soil and its products. Man has, in



WAITING FOR THE FARMER AT MILKING TIME
Caring for his dairy cattle is one of the farmer's many tasks.

the past, been wasteful with land, but now he is learning how to conserve its productive value. Soils are studied and means of preserving their fertility adopted. Studies are made of insects, so that ways may be found to prevent crops and animals from being destroyed. Problems such as soil erosion, irrigation, dry farming, and moisture control are made the basis of field surveys and tests.

Through the experiments conducted in these schools and laboratories, a vast field has been opened for agriculture in industry. The soybean and the peanut, once considered of little value, have been found to be good for cereals, bread, dressings, paints, oils, automobile parts, and other articles in use today. Fruits and grains have been improved and changed. Instructions to farmers on how to use and save their soil are given freely.

Experiments in agriculture, to increase yield and quality, are continually being carried on. Luther Burbank was typical of the most famous men in the field of plant breeding. He developed, among other interesting and unusual varieties, the seedless apple, the delicious white black-

berry, the Burbank potato, the stoneless plum, and a variety of wheat that yields fifty bushels to an acre.

Many sciences enter into agriculture, among them geology, entomology, bacteriology, and botany. It is on science that agriculture depends for progress.

The Farmer. Before the coming of the automobile, radio, and electric light and power, the life of the farmer was not an enviable one. He was in a measure isolated from the rest of the world, and many of his kind, dissatisfied with farm life, left it to go to the cities. But times have changed. Good roads and the automobile have brought the farmer close to the city, where he can not only market his produce but seek recreation. Radio permits him to know immediately what is going on in the world; it gives him valuable advice on his crops, and tells him the price of his products as soon as they are announced in the markets. Electricity gives him a convenient form of lighting, and power to run his cream separator, pump, washing machine, ice box, etc. His schools and state universities are among the finest.

But the farmer's life, though easier, is not a lazy one. The successful farmer must be a scientist and businessman, all at once. He must have a knowledge of weather, of machinery, and of chemistry. He must experiment and ward off the attacks of insects and drought and flood. But, above all, he must have a love for land and for growing things. His responsibility is to feed and clothe the world. That is the most important job of any.

The important crops and animals mentioned in this article are described in this work under separate headings.

AGRICULTURE, DEPARTMENT OF. This government department furnishes information to farmers and others engaged in agriculture to help increase and improve products of the soil, and to regulate production. Most countries of the world have such departments in their government.

The United States Department of Agriculture dates back to 1836, when the government started distributing seed to farmers. In 1862, a Bureau of Agriculture was created in the Department of the Interior. In 1889, the Bureau became a separate agency under the Secretary of Agriculture. The Department now includes the Agricultural Research Administration (including bureaus of Animal Industry, Dairy Industry, Agricultural and Industrial Chemistry, and similar agencies), the Farm Credit Administration, Forest Service, Rural Electrification Administration, Federal Crop Insurance Corporation, Commodity Exchange Authority, Farmers Home Administration, Production and Marketing Administration, Commodity Credit Corporation, Soil Conservation Service, Extension Service, and various staff offices.

In Canada, the Department of Agriculture has the Minister of Agriculture as its chief officer. The Department includes the Experimental Farms Service, Marketing Service, Production Service, Science Service, Farm Loan Board, and the Wheat Board. All wheat produced in Canada is marketed by the Wheat Board.

AINO, i'no, or AINU, i'noo. One of the original peoples of the islands of Japan, the Ainos, lost their homeland to Japanese conquerors many centuries ago. Today, most of the 18,000 Ainos live on Sakhalin and Hokkaido islands and the Kurile group.

They are small people, usually less than five feet in height, but their hairy bodies are strong and active. Their hair is black, their complexion brown.

Ainos worship a number of gods and animal spirits. One of the animals they worship is the bear. Each year a bear cub is captured, kept in a cage in the village, is fed well, and treated kindly. By the time of the great religious festival, the bear has grown large and fat, and it is killed and eaten amidst much rejoicing. See JAPAN.

AIR. See ATMOSPHERE.

AIR BRAKE. With a hot, gusty roar, the mighty locomotive thunders past the platform. Some cars flash by, and then, with a long sigh at coming to rest, your car stops smoothly in front of the spot where you stand with your luggage.

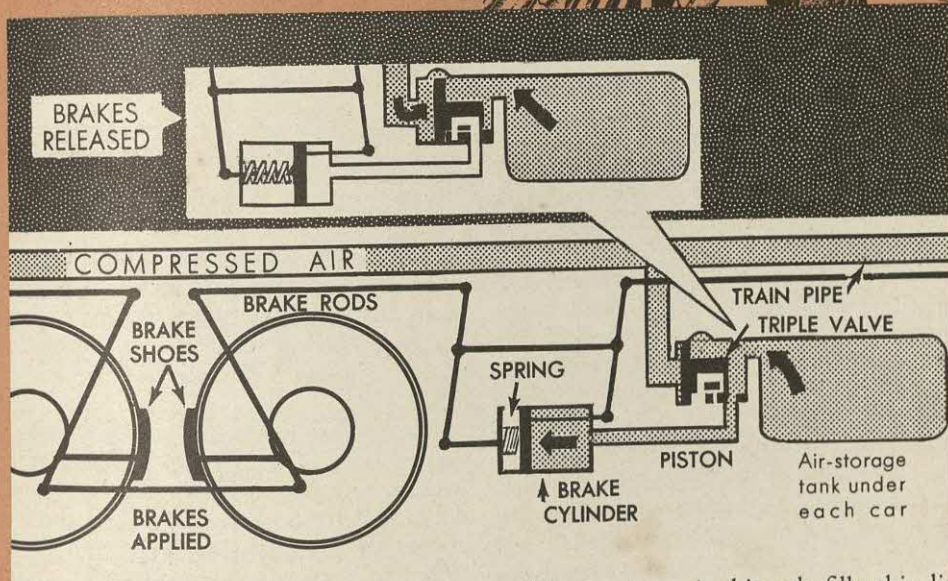
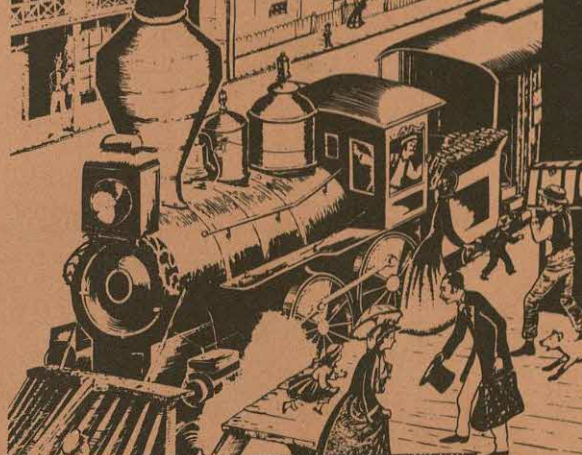
The sigh you hear is made by escaping steam and air, carried from the engine through the entire length of the modern train. It calls attention to that valuable device, the automatic air brake. Just as other mechanisms up forward employ the power of steam to make the train go, the air brake uses the power of compressed air to make the train stop.

Most railroads have the air brake as standard equipment today, but this relatively simple safety agent was just a dream until shortly after the American Civil War. Then, a New York boy with a mechanical turn of mind proved that there was something better and safer than the clumsy hand brakes in general use at the time.

He was only twenty-two when he took his plans to railroad financiers, and after many discouragements, found one sufficiently interested to fit a special train with the new brake control and make trial runs. The young man's invention was so successful that it won the approval of America's rapidly growing railroad empire almost

STOPPING THE IRON HORSE

When the engineer moves his brake valve, air is released from the train pipe, causing the triple valve to move. The movement of the valve permits the air in the car reservoir to reach the brake cylinder. There, the air pressure forces the piston forward, so that it presses the brake shoes against the wheels. The air brakes are applied in the diagram below, which shows the wheels and braking mechanism of a railroad car. The inset at the top of the diagram shows the brakes released.



overnight. This farsighted youth was George Westinghouse.

The Mechanism. Improvements have been made on the air-brake model brought out by Westinghouse in 1868, but his original idea is still the principle of air-brake operation. A compressor pump keeps a large reservoir on the engine filled with air at a pressure of from 120 to 140 pounds to the square inch. From this reservoir a pipe runs back to a flexible hose connection which may be quickly joined to the matching air hose of any car, tender, or locomotive. Every car has piping running under its length, and when all between-car connections are properly made, a continuous airtight line runs from the engine reservoir to the last car or caboose.

The engineer in his cab fills this line with compressed air, or empties it, merely by moving a convenient control. A small auxiliary reservoir on each car receives compressed air from this train pipe. Mounted under each car are: (1) the *triple valve*, which is the automatic element of the device; and (2) a *brake cylinder* connected with the brake shoes by brake beams and pull rods.

How the Air Brake Works. When the engineer starts his train, he looks at his gauges to make sure that the train pipe and car reservoirs are filled with air at the right pressure, which keeps the triple valves closed in balance. When he stops his train, he moves the air-brake control in his cab just the necessary

distance to let out some or all of the air pressure in the train pipe. Then this happens under each car. the automatic triple valve, which has been balanced between equal pressures in the train pipe and car reservoir, moves toward the reduced pressure of the train pipe. It so opens a gate through which air from the car reservoir rushes into the brake cylinder. This pushes on the piston of the brake cylinder, which, in turn, acts on the brake levers to tighten the brake shoes against the wheels and thus stop them from turning.

To release the brakes the engineer reverses the control; then pressure from the main reservoir fills the train pipe, the triple valve under the car moves back in balance, opening the way for pressure in the brake cylinder to escape, and a powerful coil spring forces the brake levers back to the "off" position.

Ease and Safety. Since every car carries its own brake-operating mechanism, every set of wheels normally reacts in the same way to the pressure in the train pipe, and there is an even braking action throughout the whole train. The skilled engineer on his high seat in the locomotive cab can handle a mile-long haul of freight, or a "crack" train of heavy Pullmans, as easily as he could roll a baby buggy.

A safety feature of air-brake operation on trains is that any break in the train pipe quickly reduces pressure and sets the brakes; a detached car or defective air system is thus immediately signaled to the engine driver, who will see that the trouble is remedied before going on. The air pressure can be regulated to cause gradual or sudden emergency braking.

The air-brake principle has been applied to some other heavy vehicles, chiefly large automobile buses and trucks. See WESTINGHOUSE, GEORGE.

AIREDALE, *air'dale*. This strong, trusty terrier, the dog that can fight and win, is named for the valley of his origin. About a century ago, miners in the district around the Aire River, in Yorkshire, began breeding dogs for strength and pluck.



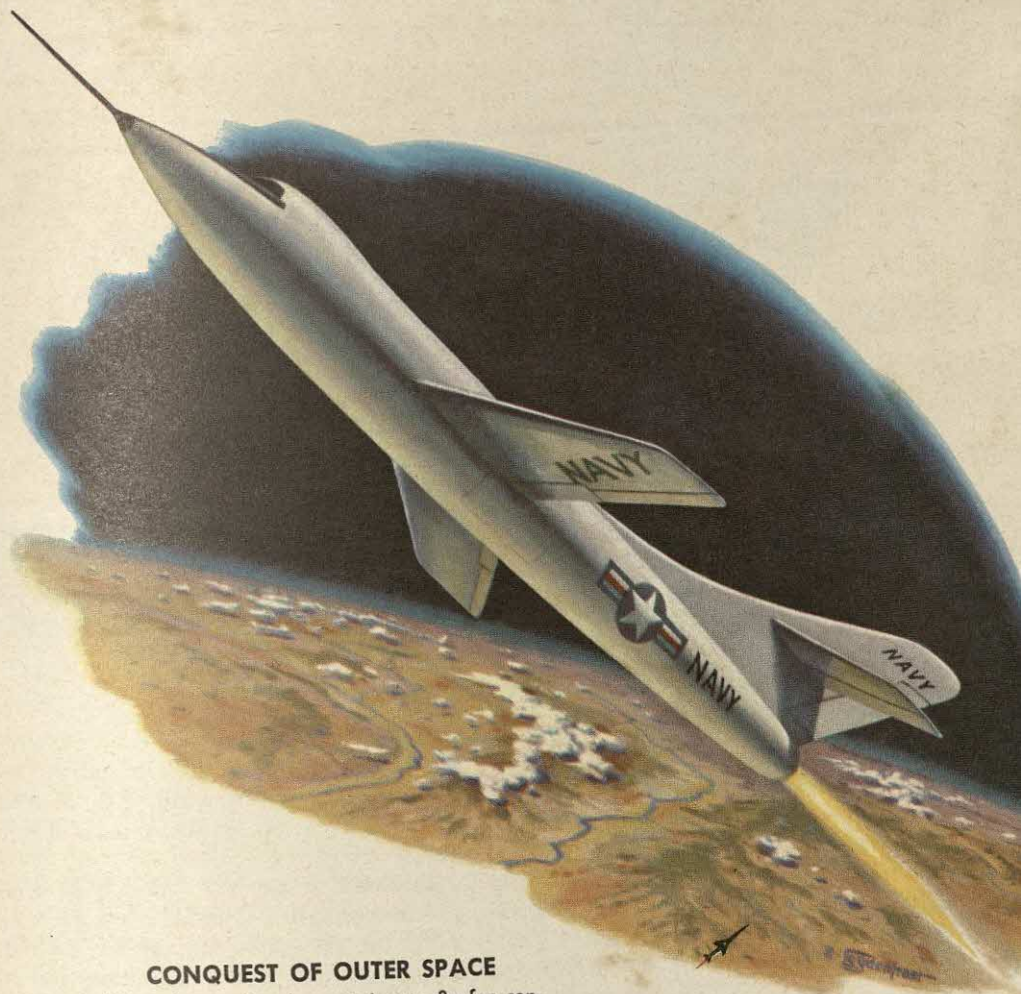
A PRIZE-WINNING AIREDALE

The plucky Britisher who is both ideal watchdog and loving companion. For courage coupled with even temper, the airedale is almost unequalled.

First they crossed the local terrier with the otter hound, and the result was a powerful dog, but one that was bad-tempered. By means of careful selection, they finally secured a breed that ran true to type, the friendly airedale that we know today.

The airedale has become a pet in many homes, but the dog is also valuable as a worker. Along a lonely section of the docks at Liverpool, the night watchman always takes his two airedales with him. When he sees a suspicious person he sends the dogs to hold him until he can be questioned. They will not attack the man unless he attempts to escape. It would be folly to run from these dogs, so strong are they, and ready for a fight. Hunters often use a pack of hounds to track down a bear or mountain lion, but two or three airedales in the pack will tree or hold the animal until the hunters arrive.

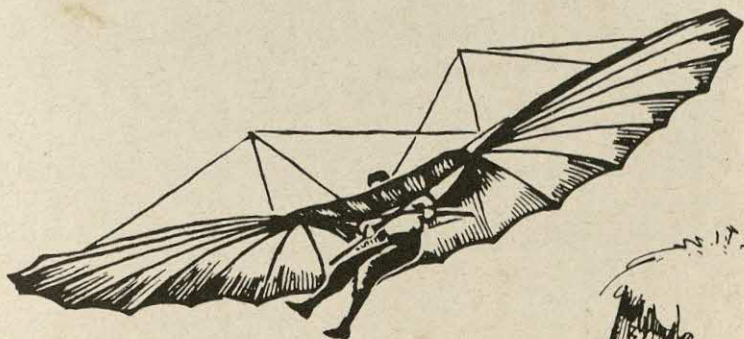
Because of their intelligence, gentleness, and ability to fight, airedales make fine watch dogs. They will guard a child and play with it, but they will not allow strangers to come near. The dogs usually weigh about forty to forty-five pounds. Their coat is stiff and wiry, the saddle and neck black or grizzle, with head and limbs tan. The tail is docked.



CONQUEST OF OUTER SPACE

Although man has been trying to fly for centuries, the first successful flight was not made until the early 1900's. Less than a lifetime later, rocket-powered planes had probed outer space to altitudes well over twenty-five miles, at speeds approaching 2,500 miles an hour. Now, man is looking forward to building space stations and making round-trip rocket ship flights to other planets. See also *Astronomy*.

Douglas Aircraft Company, Inc.





OFF TO NEW ALTITUDE AND SPEED MARKS

The rocket-powered X-15 leaves its B-52 mother plane to set two world records — an altitude mark of 136,500 feet and speed record of 2,196 miles per hour.

AIR'PLANE. A person breakfasts in London, lunches aloft, and dines in New York, all in one day. Letters mailed in Boston are delivered next day in San Francisco. Supplies and medical aid reach a lonely Eskimo, hundreds of miles from civilization, in a few hours. How Marco Polo, Columbus, Magellan, or Daniel Boone would marvel at the way man now crosses the continents and oceans in hours and days, instead of months and years—by airplane!

Man is no longer chained to earth as he used to be; no longer is he hemmed in by mountains, deserts, and water; no longer is he thwarted by icy wastes or trackless jungles. He has broken his bonds and taken to the air.

With the airplane, man has made the world smaller. He has brought the millions living in all parts of the earth closer together. He has explored the world with a speed that could be only dreamed of a generation ago.

It seems almost like a fairy tale that the airplane could become so important to man as it has in its unbelievably short career.

Yet, every day thousands of people and valuable property are whisked through the air, and we accept it as a regular part of life.

Pioneers of the Air. Did it all come about overnight? Almost, when one compares the growth of the airplane with the centuries it took man to learn how to travel speedily on the ground, and the hundreds of years before he could sail great distances safely in boats. But, young though the airplane is, flight has been in the mind of man ever since he first saw birds.

Leonardo da Vinci, the great Italian artist and scientist of the fifteenth century, studied the birds, and believed that man could imitate their flight with artificial wings. He went so far as to build such wings and test them. In 1809, an Englishman, George Cayley, made the first model of a biplane with fixed wings. He found out some of the basic reasons why airplanes fly. Forty years later, an Australian, John Stringfellow, exhibited a model of an airplane with three wings, powered by steam.

Toward the end of the nineteenth century, two men made very important con-

tributions to the future airplane. One of these was Otto Lilienthal, a German who perfected a bat-winged glider. In 1897, on the day he was to experiment with an engine attached to his device, he was killed. The other man was Octave Chanute, a Frenchman living in America, who laid down the basic design for modern planes.

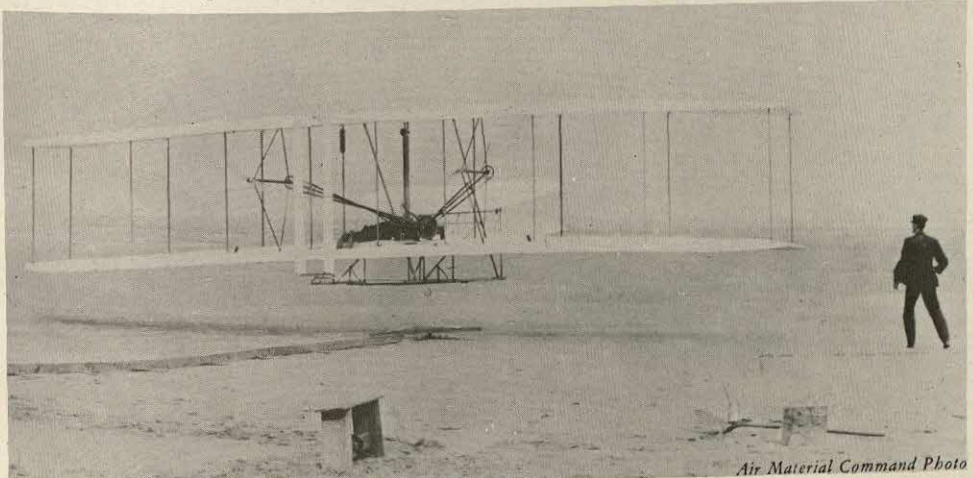
Also experimenting at this time with engine-driven airplanes was Professor Samuel Pierpont Langley, of the Smithsonian Institution, who found that the gasoline engine was best for airplanes since it could be made lighter than other types of engines, and quite as powerful. A plane he built crashed on its first take-off, or Langley might have become the first man to fly a self-propelled, heavier-than-air machine.

While Langley was experimenting with engines, two brothers, Wilbur and Orville Wright, of Dayton, Ohio, made a machine they thought would fly. They built their own gasoline engine for it, and then took the machine to the sand dunes of Kitty Hawk, N. C. There, from the slope of Kill Devil Hill, on December 17, 1903, Orville Wright became the first man to fly an engine-driven plane. His flight lasted only twelve seconds, but it was a flight, nevertheless, and it is regarded by the world as the birth of the airplane.

The Wright brothers improved their airplane, contributing to aircraft design their unique wing-warping effect which preceded ailerons as a means of control in flight. They went to France where, with the support of the French government, they experimented further. In 1908, Wilbur Wright flew an airplane 77 miles in two hours, 18 minutes, and 33 seconds at a height of 2,280 feet.

Progress from War Clouds. From that time until the First World War, France was the leading nation in the development of the airplane and airplane engines. A French plane was made that would travel 85 miles an hour, rise 3,500 feet in five minutes, and cruise 300 miles. Other countries took interest in aviation, too, and in New York, Glenn Hammond Curtiss opened the first airplane-manufacturing plant in the United States.

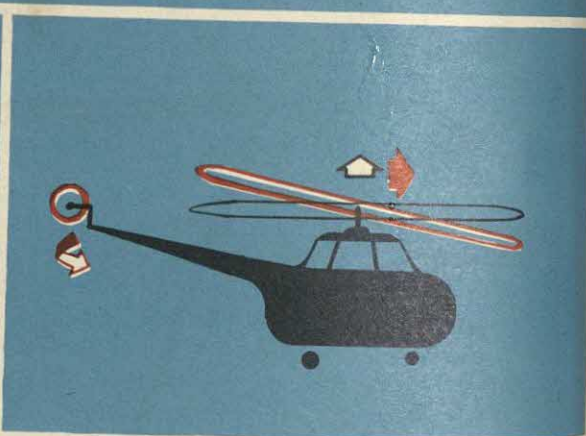
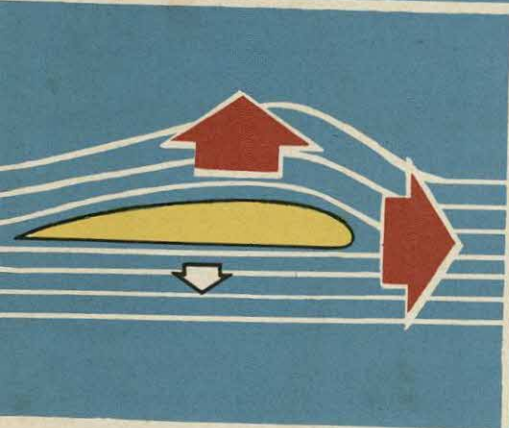
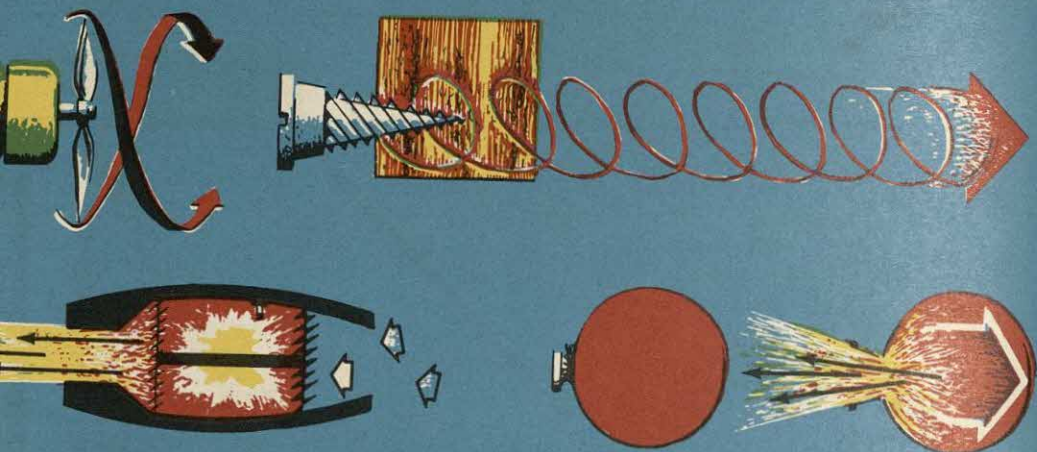
When World War I broke out in 1914, the airplane was only eleven years old. Few military experts thought that it would have any real use in warfare. The armies in Europe first used airplanes to scout and observe the enemy. Then England, France, and Germany developed planes that could fly at 150 miles an hour, climb 6,000 feet in five minutes, and cruise 1,000 miles. Gears permitting machine guns to fire bullets



Air Material Command Photo

THE WRIGHT BROTHERS' EPOCH-MAKING FLIGHT

This is a reproduction of a kodak picture of the world's first flight by a heavier-than-air craft, on December 17, 1903. Orville pilots the plane, while Wilbur runs along side.



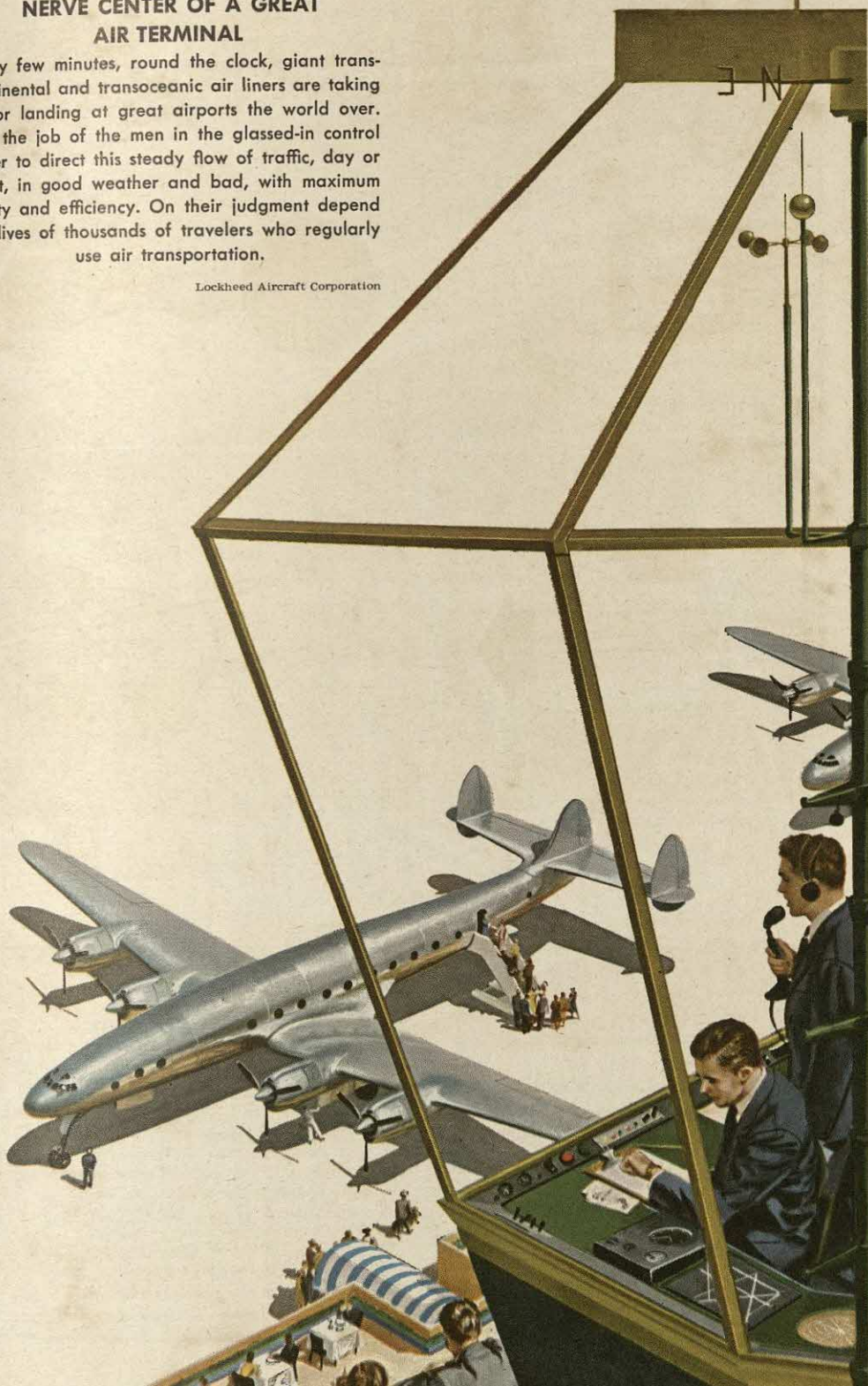
WHAT MAKES IT FLY?

A propeller-driven plane is both pushed and pulled forward as the propeller cuts through the air, increasing the pressure behind it and decreasing the pressure in front. Rotating and advancing, the propeller is an "airscrew" (top row of diagram). A jet-propelled plane is thrust forward by the jet of hot gases rushing backward through the tail. It blasts itself through space, like a balloon that is inflated and then released (second row of diagram). A plane is kept aloft by its wing, which is shaped and tilted in such a way that it forces upward the air passing over it. Thus the pressure above is decreased so that the plane is sucked upward as well as pushed upward by air under the wing (bottom left). The helicopter, which has no wing, is moved and controlled by the angle, or pitch, at which its rotor blades bite into the air as they whirl around. To go up, for example, the pilot adjusts the angle of the blades so that the overhead rotor bites the air hard on all sides, providing lift as the blades cut through the air. To go forward, he adjusts the pitch so that the overhead rotor bites hard into the air at the rear, lifting the ship's tail and sliding the ship forward. The small tail rotor keeps the ship from swinging in a direction opposite to that of the main rotor. By increasing or decreasing the tail rotor's pitch, the pilot can turn the helicopter to the right or the left (bottom right).

NERVE CENTER OF A GREAT AIR TERMINAL

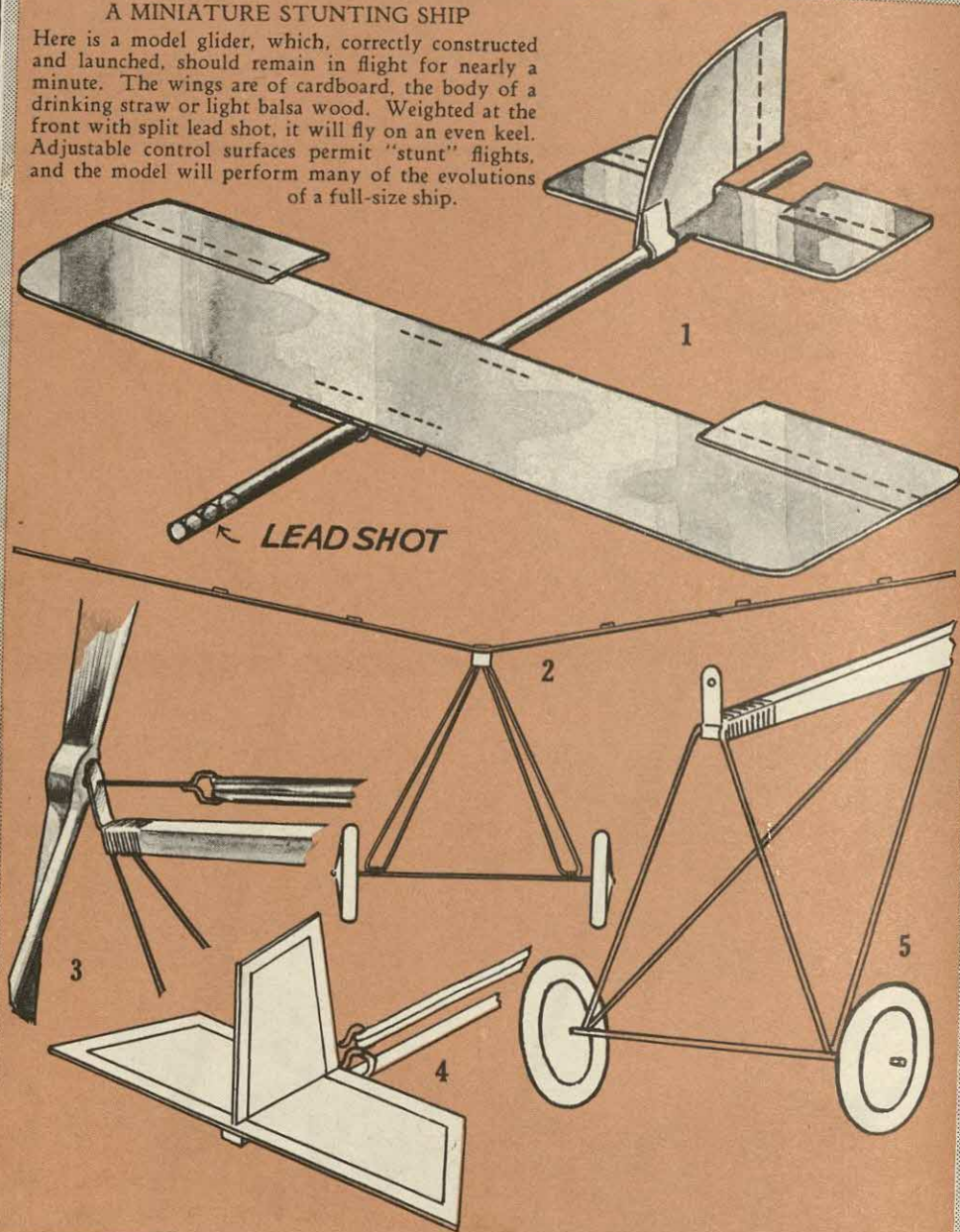
Every few minutes, round the clock, giant transcontinental and transoceanic air liners are taking off or landing at great airports the world over. It is the job of the men in the glassed-in control tower to direct this steady flow of traffic, day or night, in good weather and bad, with maximum safety and efficiency. On their judgment depend the lives of thousands of travelers who regularly use air transportation.

Lockheed Aircraft Corporation



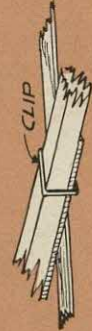
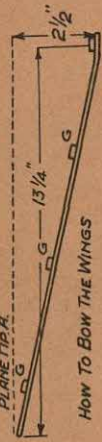
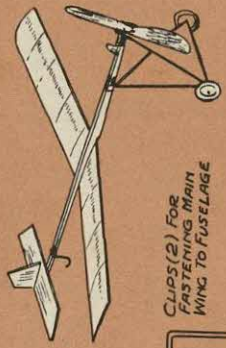
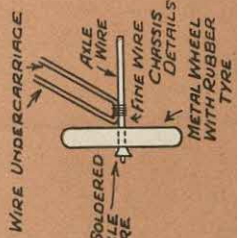
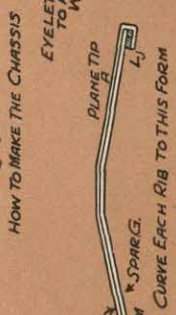
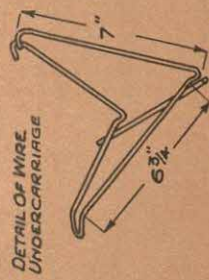
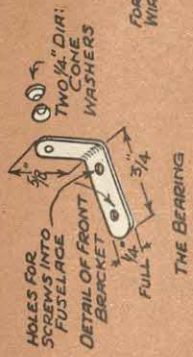
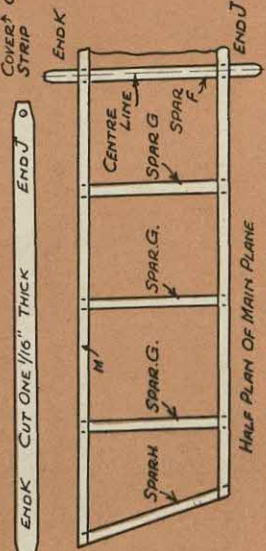
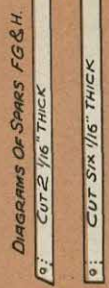
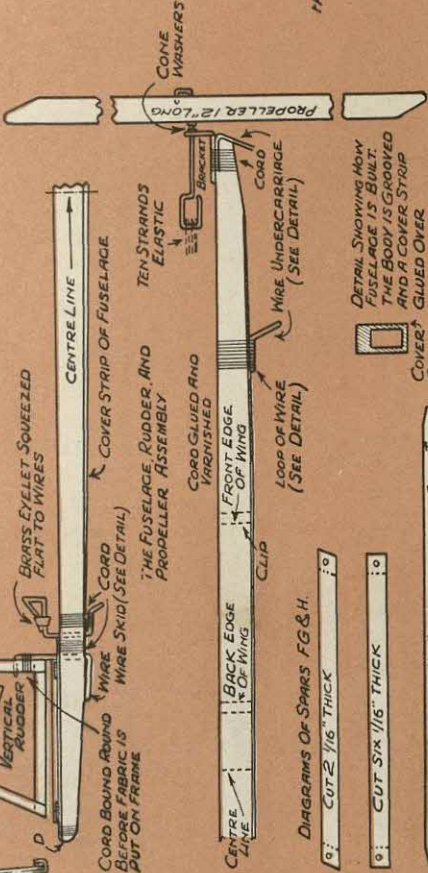
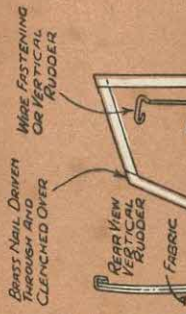
A MINIATURE STUNTING SHIP

Here is a model glider, which, correctly constructed and launched, should remain in flight for nearly a minute. The wings are of cardboard, the body of a drinking straw or light balsa wood. Weighted at the front with split lead shot, it will fly on an even keel. Adjustable control surfaces permit "stunt" flights, and the model will perform many of the evolutions of a full-size ship.



BUILDING A "BACKYARD AIRPLANE"

Above are details of the airplane shown on the opposite page. It can be built easily and cheaply and will fly surprisingly long distances. Body and propeller are made of silver spruce or balsa, and the wings, rudder, and tail from the same wood are covered with air-proofed silk or rice paper. (2) The correct angle at which to bend the wing after construction. This is known as the dihedral angle, and the model will not fly properly unless the wing is so bent. (3) Propeller and elastic, showing method of mounting on fuselage. The propeller must be carefully carved and balanced for the best results. (4) Assembly of tail, rudder, and rear hook. The hook holding the elastic is bound on with thread, then glued with liquid cement. (5) The undercarriage, made of piano wire, and attachment to body. Wheels may be purchased as shown.

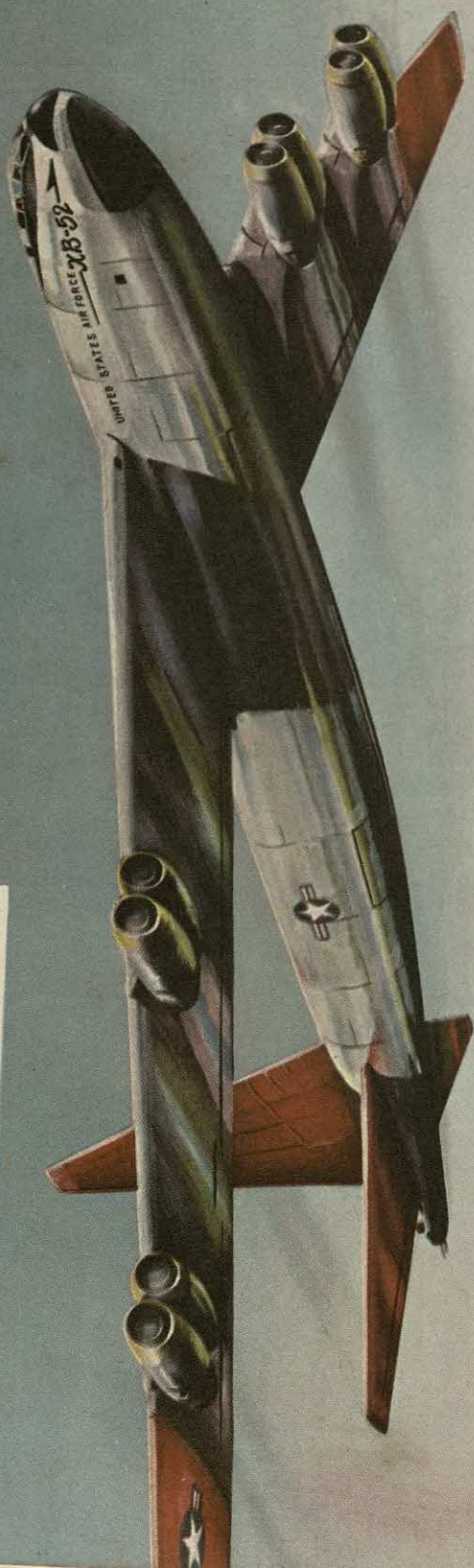


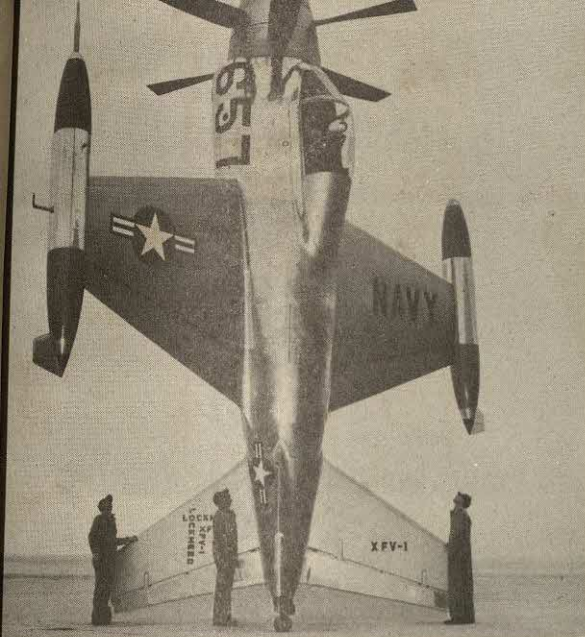
YOU'LL FIND THIS EASY-TO-BUILD POWER MODEL FUN TO CONSTRUCT AND A TOP-NOTCH FLIGHT PERFORMER!

THE JET REVOLUTION IN AIR TRAVEL

During the 1950's, jet-powered planes such as the B-52 rapidly displaced propeller-driven military aircraft. The first commercial jet flights, between England and South Africa, were made early in 1952.

Boeing Airplane Company





Lockheed Aircraft Corp. U.S. Navy

"STRAIGHT UP" AIRPLANES

The Navy "pogostick" airplane (left) was the first plane to take off from a vertical resting position. The "Flying Carpet" platform (right) is an individual helicopter designed to serve the armed forces.

between the whirling blades of the propeller were invented, and planes became fighting machines.

Aviators learned how to "loop" their planes, how to dive and gain speed. Squadrons flew in "V" and "ladder" formations for protection. Planes would leave the formations one by one as they met the enemy squadrons, and battle each other individually, in dramatic "dog fights." These were the thrill-packed hours of Guynemer, Richthofen, Bishop; of Rickenbacker and Luke, famed "aces" of the first major war in the air. Larger and stronger planes were built, with more powerful and dependable engines.

Pursuit planes with two wings were used generally for fighting. Then came the multi-engined bombers. These were huge machines, carrying as many as twelve men and hundreds of pounds of deadly bombs. Many were made with three wings, but these were hard to control. The bombers were very slow, and when they were sent out to drop their missiles, the smaller, faster, and more agile fighting planes had to escort them to ward off attackers. Because each army sought to have better air-

planes than the other, improvements were made quickly.

In the years following World War I and during World War II, sensational improvements were made in all types of warplanes. Bombers became larger, more powerful, and speedier; interceptor and pursuit planes became marvels of quickness in respect to both speed and maneuverability. One of the most remarkable developments of the Second World War period was that of a fast, jet-propelled fighter.

The Airplane Goes to Work. After the First World War, airplanes were put to peacetime use. In the United States, the air-mail service was organized in 1918, the first line being established between New York and Washington. It was extended to the rest of the country, but the mail could be carried only during the day, for aviators had much to learn about flying at night. Then, in 1923, the first night air-mail service was inaugurated, and air-beacons were placed throughout the country to guide the pilots. Today, the airliners carrying mail and passengers fly in any kind of weather and at all hours. They follow the air routes by the use of radio facilities, which include the

PILOT CALLS TOWER FOR PERMISSION TO TAKE-OFF

CAA OFFICES
AIRLINE OFFICES
OPERATIONS OFFICE
PASSENGER LOUNGE
WEATHER BUREAU

CONTROL TOWER

OPERATIONS DECK

PASSENGER WAITING ROOM

PASSENGER UNLOADING

PASSENGER LOADING

PILOT CONTACTS TOWER AND RECEIVES TAXI AND TAKE-OFF INSTRUCTIONS

TOWER CALLS PILOT AND GIVES HIM TAXI INSTRUCTIONS

ENGLAND

36 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

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ENGLAND

36 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

PILOT CLEARS WITH TOWER TO SWITCH TO AIRWAY TRAFFIC CONTROL FREQUENCY

CARGO LOADING

ENGINE AND PROPELLER OVERHAULING

AIRCRAFT MAINTENANCE

HANGAR STORAGE

A TYPICAL AIRPORT

A TYPICAL AIRPORT

radio "beam" and radio direction-finders or "loop" compasses.

As the air mail became successful, air-minded men turned their attention to passenger service. This branch of aviation started with short flights. There was little regulation, and the planes were neither very large nor very safe. Before the outbreak of war in 1939, however, fast, reliable airliners spanned the world in regular flights.

Great planes now cross North America daily. Some are equipped with berths like railroad sleeping cars. They make the trans-continental journey overnight whereas the same journey by rail would require three nights.

Before World War II, large flying boats carrying forty-four or more passengers traveled to cities in South and Central America and the West Indies. Similar planes began flying from San Francisco to the Philippines in 1939, to China in 1940, and then to Australia and New Zealand. These clippers were replaced by faster and more efficient four-engine land planes in 1941 and 1942.

Planes have regularly crossed the Atlantic between Africa and South America since 1933, and in 1939 Europe and North America were linked by transoceanic flights. The first of the *Stratoliners*—capable of flying above most weather at about 22,000 feet—were put into service in 1940; the crew and passengers of these huge transports can ride in comfort at this altitude, because the cabins are airtight and the air pressure in them is kept equal to that at 8,000 feet.

By 1939, air lines formed a network across Europe, and extended also to the British, French, and Dutch possessions in Africa, Asia, and the Far East.

But there is more to the operation of air lines than just flying. Carefully trained stewards and stewardesses are employed to look out for their passengers' comfort. Men especially trained in radio engineering must keep contact with the pilots so that they may be informed at all times

of weather conditions. Mechanics and engineers, to keep the planes in perfect condition, ticket sellers and other men to administer the affairs of the company, are needed on the ground. In fact, for every plane that flies passengers, between thirty and forty persons are employed to keep it flying safely and on time.

The major air routes in Canada are controlled by Trans-Canada Air Lines, a corporation that is part of the government-owned Canadian National Railways. The corporation was organized in 1937 and now operates about 21,000 route miles. Another corporation, which operates north-south routes, is Canadian Pacific Airlines. It flies almost 23,000 route miles and makes stops at northern prairie towns, fur trading posts, and mining towns.

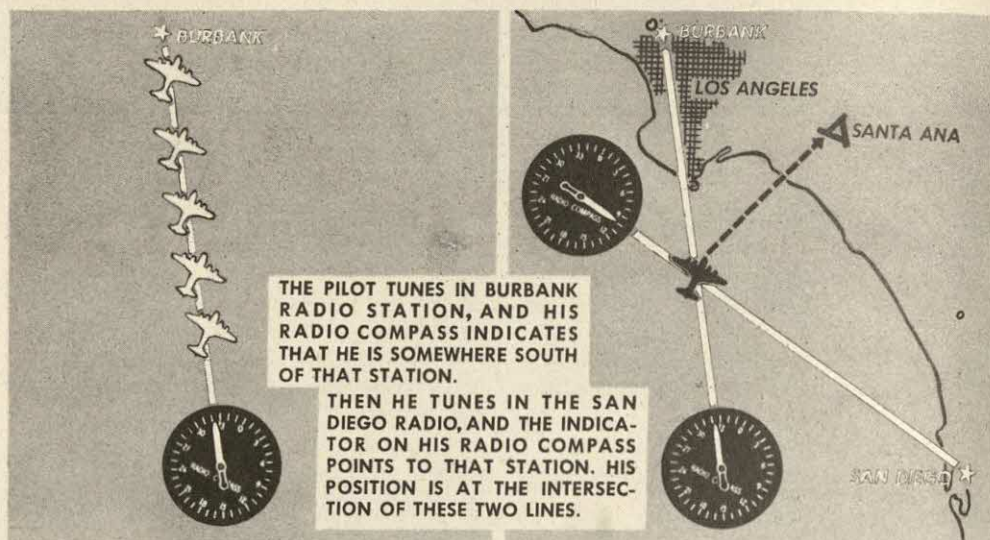
Vertical-Rising Aircraft. Igor Sikorsky, the Russian inventor, made the first practical helicopter in 1939. Since that



United Air Lines

STOWING CARGO

So big are the commercial planes of today that mechanical hoists—or "elevators"—have been developed to get their cargo aboard. Some of the air giants are veritable boxcars, carrying freight instead of passengers and their baggage.



THE RADIO COMPASS HELPS THE PILOT FIND HIS WAY

time, this and other types of vertical aircraft have been adapted to many uses. A helicopter can serve as a "crane" carrying cargo between ship and shore. It can be fitted with spray bars through which insecticide can be sprayed to destroy various farm pests. A helicopter can hover above any area to let its occupants have a close look at what is below. This makes the plane useful to cowboys hunting lost cattle or to policemen directing traffic. Some jet planes can take off and land vertically.

The Sailplane. Another form of plane that has been developed through man's experiments in the air is the sailplane. It is actually older than the airplane, but, until recently, it was not improved much. Sailplanes are beautifully designed monoplanes without engines. They sail through the air rather than propel themselves, and men have become so skillful at soaring on air currents that they have been able to remain in the air for thirty-eight hours, and to rise to heights of over 28,000 feet.

Why Airplanes Fly. The airplane has never ceased to be a wonder to those who know little about flying. How can a machine that is heavier than air stay up? How is it able to maneuver? These ques-

tions are not very difficult to answer, even though it took man years to find the answers. First of all, we must remember that air is a substance. It has weight and pressure just like water. When there is less pressure above a wing than below, the air underneath will support it. A whirling propeller pushes through the air just as the propeller of a boat progresses through water, or a screw twists its way into wood.

Two forces are necessary to lift an airplane into the air and keep it there: one is an upward force, and the other is a forward force. The upward force depends on the forward movement of the plane. You may have noticed that the wings of an airplane are not flat, but curved from a thicker front edge to a thinner rear or trailing edge. When the plane moves forward, a partial vacuum is created above the wing. This pulls the wing upward, while the air underneath the wing adds to the total lifting power necessary to support the entire machine. Thus the size and shape of the wing determine, to a large extent, the performance of any airplane. A kite acts in much the same way. It lifts into the air when we run with it because the forward motion creates an upward push.

How Airplanes Are Built. Two types of airplanes, structurally speaking, have been developed. These are the monoplane (one wing) and the biplane (two wings, one underneath the other). In the past the biplane was favored because of its strength and safety, but these factors have been incorporated into monoplane design. The *fuselage* of the airplane is the main body. In it is the cabin for the pilot. In larger planes, there are compartments for pilots, passengers, mail, and freight. The fuselage is constructed of long tubes called *longerons*, braced by *trusses*. It is entirely covered with a metal or cloth "skin."

Next come the wings. These are made of long supports called *spars*, to which *ribs* are joined. They resemble small cantilever bridges in their construction. All the material in the skeleton is light metal or wood, but very strong. The wings are rounded on top toward the front. This arrangement is called the *cambered* wing, and the purpose of such construction is to keep the air flowing smoothly over the wing so that the wing will lift and go forward, but not be pulled back. The wings and fuselage are streamlined in order to present as little resistance to the wind as possible.

Engine designs vary. Some are radial with cylinders in a circle, and air-cooled. Some have cylinders in a line, liquid- or air-cooled. Others arrange cylinders in the shape of a "V." Except for jet-propelled planes, for all practical purposes planes now use gasoline engines. The propeller is set at an angle to provide the best forward pull through the air, and may be adjusted to give the correct angle for landing, for taking-off, or for speed.

At the rear of the plane is the rudder, a vertical flat air surface that is hinged to the *fin*. It is worked by the pedal controls in the pilot's cabin. The short horizontal, winglike devices branching out from the rear of the fuselage are the *elevators*. They are hinged to the *stabilizer* and are worked by the control stick or wheel. The control stick in the cabin also manipulates the *ailerons* on the wings which are necessary for

banking, or tipping a plane to make a turn.

Operation. Most planes are equipped with a wheel, but the control stick still is used on some small planes. In flight, to bank and turn left the control stick is moved left, and the left foot control is pressed. This turns the rudder to the left and raises the left aileron. The left wing then goes down and the right wing up. After the plane has completed the turn, the stick and foot control are restored to their normal positions.

To bank right, the stick is moved to the right and the right foot-control pedal is pressed down. In order to climb, the stick is pulled back, raising the elevators. This causes the rear end of the plane, the tail, to go down, while the front rises. To turn left and climb at the same time, the control stick is pulled back and to the left, and the left foot control is pressed down.

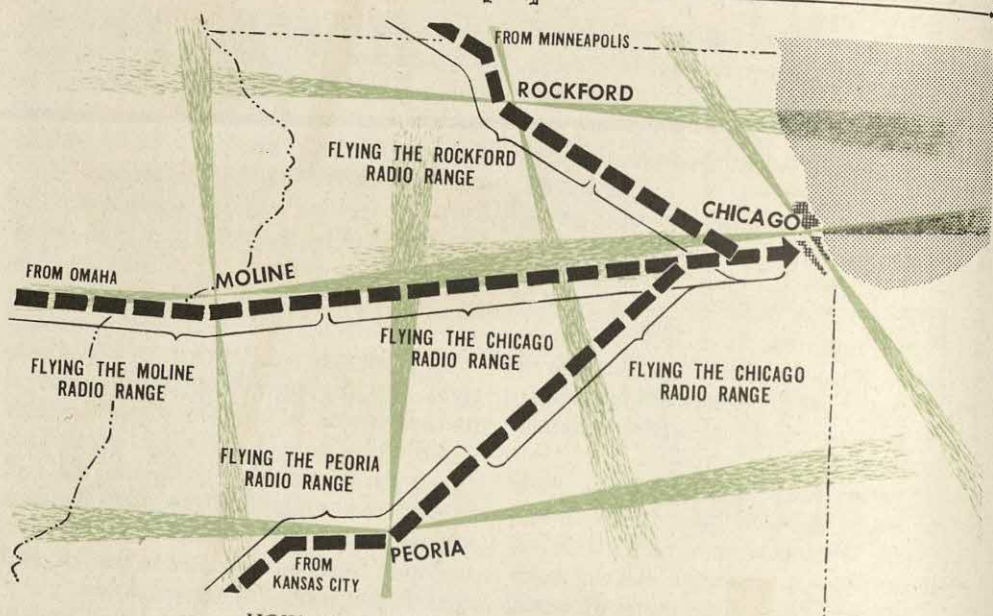
But even though you may know how to work the controls of an airplane in flight, there is much more to know in order to fly in this scientific age. There are many instruments in the cabin that must be watched carefully. Some of these are the



United Air Lines Photo

THE CONTROL TOWER

This is the nerve center of an airport. Highly skilled traffic-control operators direct incoming and outgoing aircraft by the use of two-way radio contact with the pilots of the airplanes.



HOW THE PILOT FOLLOWS THE BEAM

tachometer, which shows how fast the engine is turning over; manifold pressure gauge; thermometers, showing the engine, oil, and carburetor heat; the oil-pressure and fuel-pressure gauges; the gasoline gauges; the air-speed indicator; the altimeter, which shows the height the plane is flying; the bank-and-turn indicator, the rate-of-climb gauge, and all the flight instruments and the radio apparatus. There are even more, but these are the more important instruments on most planes.

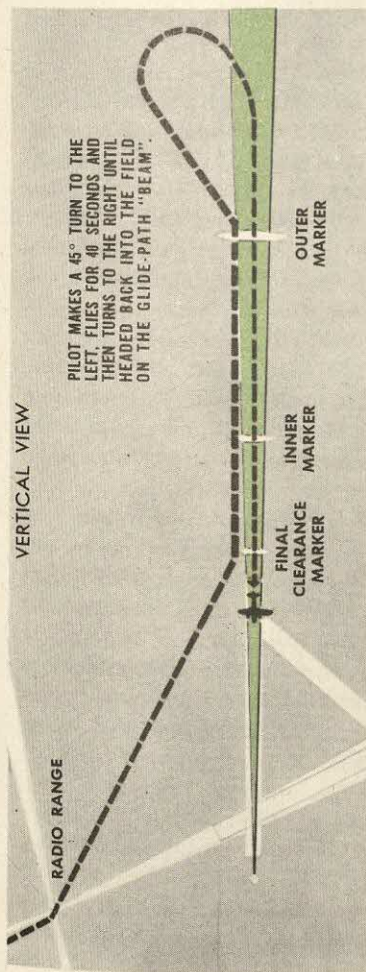
"Blind" Flying. Instruments have become so accurate that it is possible for an aviator to pilot his plane in fog, rain, snow, and blizzard without ever seeing the ground, the sun, or the stars. Instruments can pilot a plane without a man's touching the controls. Three of the most important instruments for this "blind" flying, as it is called, are the *directional gyroscope*, which indicates when a plane is deviating from its course; the *artificial horizon*, which shows whether the plane is flying straight and level, and *radio apparatus*.

For instance, a plane is flying in a dense fog west to Chicago. The radio station at the Chicago airport is sending out radio

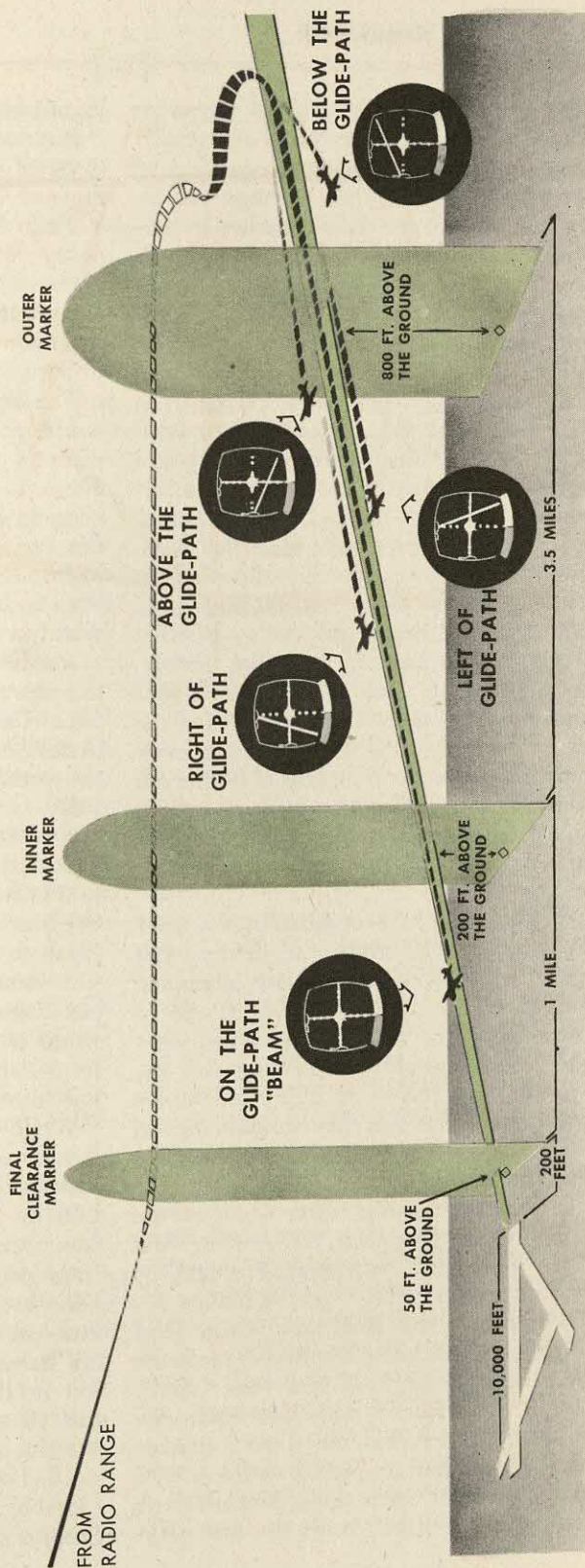
"signals" in fanwise fashion, forming a circle around the city for a distance of many miles. The circle is divided into four sections, the signal for the east and west quadrants being "A" (dot-dash), repeated over and over again, that for the north and south quadrants being "N" (dash-dot).

These two signals alternate in the four quadrants of the circle. Where the "A" and "N" signals overlap, there is a steady hum in the radio receiving set. The pilot of the plane flying west hears the "A" sound and follows it. Then he veers to the north or south until he receives the "hum." That is his radio "beam," and he follows this "hum" to the airport. He can tell whether he is off his course if he hears either the "A" or "N" signal alone. His two-way radio keeps him in communication with the airport and he is informed of the weather and other conditions for landing.

But, suppose the pilot cannot see the airport. Then he must land "blind." Two systems of blind landing have been developed. One system employs the use of radar; the other, the use of two radio "beams." In the first method, called Ground Control Approach (GCA), the



This is a diagram of the Instrument Landing System (ILS) used by pilots to assist them in landing during bad weather. The pilot follows the radio range to the station, then turns on his ILS instrument. He flies out beyond the Outer Marker, turns around, and follows the glide-path beam down to the station. When the two needles on his ILS instrument cross at the center, he is on the correct glide-path. GCA (Ground Control Approach) operates similarly, except that an operator on the ground uses radar to guide the pilot down to the runway.



radar operator on the ground knows at every moment, by radar "blips" on his two scopes, the altitude and course-bearing of the aircraft making the landing. He informs the pilot by radio whether to correct his heading to the left or right or whether he is above or below the glide-path, so that the plane will make contact with the landing-strip at the proper place.

The second blind-landing method is the Instrument Landing System (ILS). It is very much like GCA except that it comprises two guiding radio-beams; one is a horizontal guidance, and the other a vertical guidance. In the aircraft is an instrument with a horizontal needle that automatically indicates whether the plane is above or below the prescribed glide-path, and a vertical needle that shows whether the aircraft is lined up with the runway. In addition, an outer marker-beacon four and two-fifths miles straight out from the end of the landing strip and an inner marker-beacon seven eighths of a mile out indicate to the pilot, by means of cockpit signal lights, his progress and his position in relation to the landing runway that he is approaching.

Flights Which Made Air History. Ever since the Wright brothers made their first flight in 1903, aviators have attempted longer, higher, and faster flights. All of them helped to prove to the world what the airplane could do, and showed the amazing progress of aviation. One of the first great flights was that of Louis Bleriot, a Frenchman, who flew across the English Channel on July 25, 1909. In 1919 the first transatlantic flight was made by the American navy seaplane, *NC-4*, which flew from New York to Lisbon, Portugal, by way of Newfoundland and the Azores.

In June of the same year, Capt. John Alcock and Lieut. Arthur Brown made the first non-stop flight across the Atlantic Ocean, flying from Saint Johns, Newfoundland, to Clifden, Ireland. Two American army planes flew around the world in 1924, and Lieutenant Commander Richard Byrd, with Floyd Bennett, made the first plane

flight over the North Pole on May 9, 1926.

But none of these flights aroused the interest of the public in aviation as did the flight of Charles A. Lindbergh from New York to Paris in 1927. Unknown to most of the world, the youthful pilot lifted his plane, *The Spirit of Saint Louis*, from Roosevelt Field, New York, early in the morning of May 20, 1927, and set it down in Paris 33 hours and 29 minutes later.

The flight captured the admiration of the world, and dozens of nonstop flights took place in the succeeding months. In 1931 Hugh Herndon and Clyde Pangborn accomplished the first nonstop flight across the Pacific, flying from Tokyo, Japan, to Wenatchee, Wash. That same year, Wiley Post and Harold Gatty flew around the world in 8 days, 15 hours, and 51 minutes.

Amelia Earhart became the first woman to make a solo flight across the Atlantic in 1932. This daring woman aviator was lost in the Southern Pacific while on a round-the-world flight in July, 1937. In January, 1937, Howard Hughes flew across the United States in seven and one-half hours. The next year, he flew around the world in 91 hours, 8 minutes. In 1945, three Superfortresses flew the 6,645 miles from Japan to Washington, D. C., in 28 hours, 42 minutes. In 1949, a B-50 bomber completed the first non-stop flight around the world in 94 hours, 1 minute; it took off from Fort Worth, Tex., and was refueled four times in flight.

While these flights were being made, speed and altitude records were broken steadily. The first speed record was set in 1906 by Santo Dumont, of France, who flew twenty-five miles an hour. In 1945, a jet-propelled airplane flew from Dayton, Ohio, to New York City in sixty-two minutes—an average of 526 miles an hour. An Italian plane flew to a height of 47,352 feet in 1934, an amazing contrast to the first record of 361 feet made by Wilbur Wright in 1908. Now, rocket planes have reached speeds of over 1,600 mph and altitudes of over 63,000 feet. See BALLOON; DIRIGIBLE BALLOON; FLYING, STORY OF.

AIR PLANTS, or EPIPHYTES, *ep' i fites*. These are plants that get all their food from the air. They have no roots that go into the soil, but they grow on other plants, especially on the trunks of trees. Some grow on rocks. In temperate and cold climates, the most common air plants are the lichens and certain forms of mosses. The so-called Florida moss is an interesting air plant that belongs to the pineapple family. It hangs in gray tufts from trees and is used for stuffing mattresses.

In the tropics, where there is great heat and moisture, beautiful orchids grow on trees and rocks, taking all their nourishment from the air. The true air plants should not be confused with forms like mistletoe, which not only grow on other plants, but feed upon them. These are called *parasites*. See LICHENS; ORCHIDS.

AIX-LA-CHAPELLE, *aks lah sha pel'*, or AACHEN, *ah'ken*. This old Rhenish Prussian city is located forty-four miles southwest of Cologne. It was the favorite residence of Charlemagne, who was crowned Emperor of the West. About in 796, he built a chapel which is the oldest part of the famous Cathedral of Aix-la-Chapelle. His remains, preserved in a gold coffin in the cathedral, were removed by the Germans for safe keeping in World War II; they were later returned. In 1815 the name of the city was changed to Aachen, but it is also known as Aix-la-Chapelle. The population is about 145,000.

Congress of Aix-la-Chapelle. After the wars of Napoleon, a congress was called in Aix-la-Chapelle to adjust the affairs of Europe (1818). To it came many rulers and statesmen. Czar Alexander I of Russia, Emperor Francis I of Austria, and King Frederick William III of Prussia were present. Among the statesmen were Metternich, from Austria; Castlereagh and Wellington, from England; Hardenberg, from Prussia; and Richelieu, the grandson of Cardinal Richelieu, from France. Richelieu secured the withdrawal of foreign troops from France, and that country was

recognized as one of the great powers of Europe, upon agreeing to the Holy Alliance.

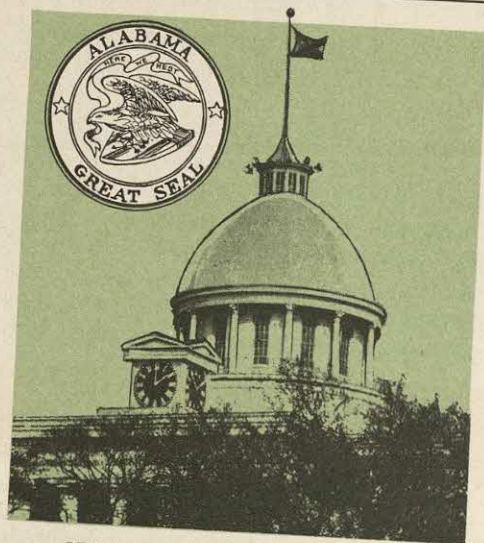
Treaties of Aix-la-Chapelle. The first treaty was concluded May 2, 1668, between Louis XIV of France and the Triple Alliance, which included England, Sweden, and Holland. After the death of Philip IV of Spain, Louis laid claim to a large portion of the Spanish Netherlands. He had already seized several fortresses when Holland, in alarm, concluded the Triple Alliance. Because Louis feared this strong combination, he accepted terms by which France retained Charleroi and Lille and gave back Franche Comté to Spain.

The second Treaty of Aix-la-Chapelle was concluded in 1748, at the close of the War of the Austrian Succession (see SUCCESSION WARS). Before his death, in 1740, Emperor Charles VI of Austria attempted to secure the Austrian succession for his daughter, Maria Theresa. Several European rulers claimed a share in the Austrian possessions, and after Charles died, all of the great powers of Europe were drawn into a general war. By the terms of the treaty the different states held nearly the same possessions after the war as before, but Francis I, husband of Maria Theresa, was declared emperor.

AK'RON, OHIO. Most of the automobiles traveling the highways of America are running on rubber tires produced in the fifth largest city in Ohio. For Akron is today the rubber-goods manufacturing center of the world. The city is also America's center of dirigible-balloon construction. Rubber processing, however, is not Akron's only claim to fame. Beds of suitable clay furnish material for pottery, tile, and terra-cotta factories.

Akron is located in northeastern Ohio. It is about thirty-five miles south of Cleveland and lies on the Cuyahoga River. It was incorporated as a village in 1836, and became a city in 1865. Akron has a population of about 291,000.

A KEMPIS, THOMAS. See THOMAS À KEMPIS.



STATE CAPITOL OF ALABAMA

A glimpse of the classic building which houses the State Government at Montgomery. Jefferson Davis here took the oath of office as provisional President of the Confederacy.

ALABAMA. In 1541 the Spanish explorer De Soto crossed the wilderness of Alabama in search of a land rich in gold, which he believed lay west of Florida. Little did he realize that the very ground he walked upon contained untold wealth, awaiting the magic touch of discovery and development. It was many years after De Soto, however, before men learned what profits the cotton, coal, and iron industries would take from this virgin land.

In the Alabama of today, the fields of snowy cotton yield about a million bales a year. Its deposits of coal and iron are among the best and richest in the country, and its lumber and textile manufacturing provide employment for many thousands of workers. Farm, mine, and factory produce the wealth that the wandering De Soto sought and never found.

Location, Area, Population. Located in the heart of the deep South, Alabama lies between Georgia and Mississippi, on the east and the west, and between Tennessee and Florida, on the north and the south. Its southern border also includes fifty miles along the Gulf of Mexico. With a total area of 51,609 square miles, Ala-

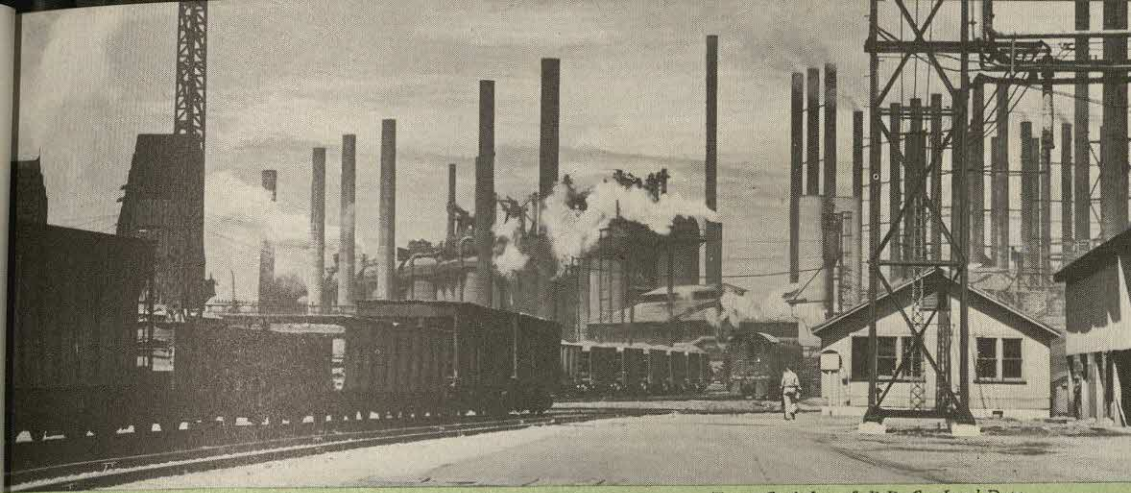
bama is twenty-ninth in size among the states of the Union. According to the census figures, the state has a total population of 3,280,000, which puts it in nineteenth place among all the states. About one third of the population of Alabama is Negro.

Mountain, Piedmont, and Plain. In the northeastern part of Alabama, the parallel ridges of the Appalachian chain reach their southern limits in the Appalachian and Piedmont uplands. Here the last of the Blue Ridge foothills fade from high mountains into the great, rolling coastal plain which comprises about half of this favored land of the Cherokees.

Near the coast the land is low and the surface slightly rolling. From the coastal belt the altitude increases, first to the sandy land of the southern third of the state; thence by another step to the hilly region north of the central "prairie"; still higher to the tablelands lying on Sand and Look-out mountains, 1,000 to 1,200 feet above sea level; and, finally, in the northeastern part of Alabama, to the higher summits of the Appalachian chain.

The altitudes and surface areas of Alabama are largely determined by the character of the underlying rocks, which in the main extend in a general northwesterly and southeasterly direction. Thus, one would get a view of each natural division of the state by making a trip diagonally across it from the Gulf to the northeastern corner.

The Working Streams of Alabama. There are 1,500 miles of navigable streams; boats travel the waterways the year round, for it is never cold enough for the channels to freeze. In the north, the Tennessee makes a great bend across the state. Here, near Florence, the Muscle Shoals development was begun by the Federal government during the first World War. Its original purpose was to supply power for near-by nitrate plants. Now, the 134-foot drop of the river's bed over a distance of thirty-seven miles has been utilized in a great hydroelectric power de-



Tenn. Coal, Iron & R.R. Co. Land Dept.

STEEL MILL CENTER OF THE SUNNY SOUTH

The blast furnaces of Birmingham are the industrial heart of the state of Alabama.

velopment. Wilson Dam is only one of a number of similar projects carried out by private enterprise and the TVA.

The Mobile River system drains the greater part of the state and includes the Tombigbee, with its branch, the Black Warrior, and the Alabama River. This system furnishes both navigable waterways and power for manufacturing. These waters empty into Mobile Bay, one of the

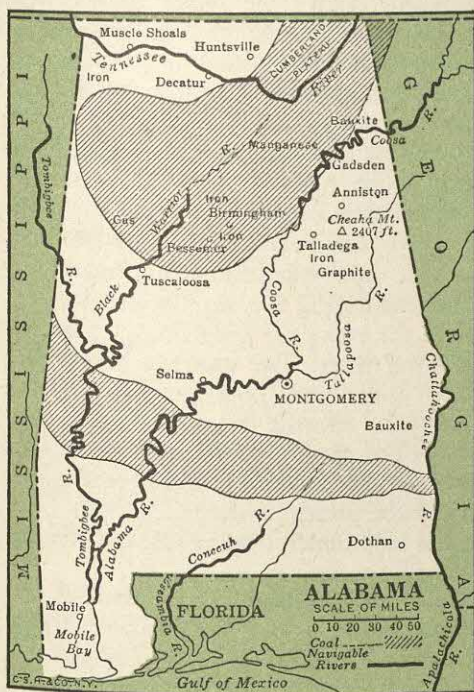
most spacious harbors in the Gulf of Mexico.

Climate. Snow rarely falls in Alabama but, when it does surprise the inhabitants, it usually comes in the northern counties. Even in that region, the temperature is usually between about 43 degrees in January and 84 degrees in July. In the north, the intense heat of summer is tempered by the elevation of the country, and in the south by the Gulf breeze.

Treasures of Mine and the Land.

Birmingham, Alabama's largest city, is in the center of a rich soft-coal area covering about 8,000 square miles in the northern half of the state. Vast iron-ore deposits are found near the coal beds, and these valuable minerals are the basis of a prosperous iron and steel industry. Birmingham, with its busy steel works, blast furnaces, and rolling mills, is called the "Pittsburgh of the South." Other minerals, too, are found in the state, including bauxite, the source of aluminum; asbestos, limestone, graphite, marble, and porcelain clays. An abundance of raw materials has made Alabama an important center of the cement industry.

Agriculture is the most important industry for the state as a whole. Because of its high yield of cotton, Alabama was once popularly called the "Cotton State," but the growing tendency to rebuild the soil through the cultivation of other crops has made cotton relatively less important



within recent years. A study of census reports over many years shows the rising value of such crops as corn, oats, peanuts, sweet potatoes, tobacco, sugar cane, hay, and a wide variety of orchard and small fruits. The dairy industry is of growing importance, and horses, mules, beef cattle, sheep, and swine are bred in large numbers. Alabama ranks fifth among the states in the production of mules.

The manufacturing industries are closely linked with the products of the land. Just as coal and iron are the basis of the steel industry so cotton provides raw material for the spindles of cotton factories, and for the manufacture of cottonseed oil and cake.

Originally almost the whole area of Alabama was covered by forests. A considerable proportion of the acreage, especially in the more hilly regions, is still in timber. The most valuable single timber is the long-leaf pine, found chiefly in the south; there are, besides, valuable stands of short-leaf pine, poplar, oak, cypress, gum, and maple. Sawmilling has long been an important industry of the state, and tanbark, turpentine, and rosin are all valuable products. The large number of wage earners employed in industry provide a steady market for the diversity of food products produced on the farms and in the orchards of Alabama.

The People and Their Government and Education. About eighty-seven per cent of the people in Alabama were born within the state. Most of the population lives in rural districts. Three cities have populations of more than 100,000: Birmingham, about 342,000; Mobile, the only Gulf port, about 193,500; and Montgomery, the capital, about 135,000.

Alabama's governor, lieutenant-governor, and other state officers are elected for a term of four years and none is eligible for re-election. Only those persons who pay the poll tax, who can read, write, and interpret any clause of the United States Constitution in English, and who have been employed most of the year preceding

registration are given the right to vote. Those who cannot read or write may vote if they own a certain amount of property upon which taxes have been paid.

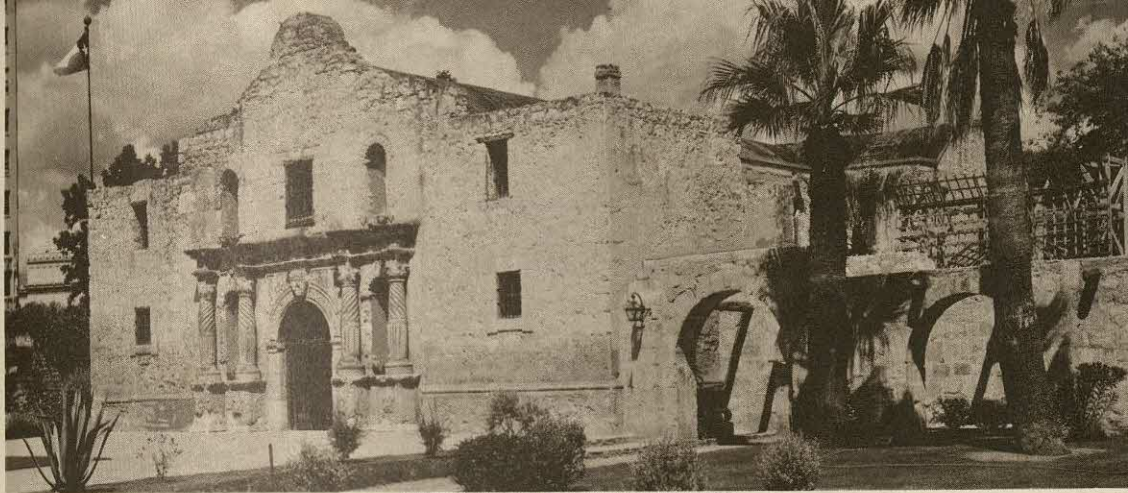
The state has 4,000 primary and secondary schools and twenty-six institutions of higher learning including the University of Alabama at Tuscaloosa and the Alabama Polytechnic Institute at Auburn. This is a coeducational college devoted to agriculture and the mechanic arts. It was founded in 1872. The Institute co-operates with the Federal Department of Agriculture in supervising agricultural extension work. One of the world's largest schools for Negroes, is Tuskegee Normal and Industrial Institute. It was founded in 1880 by Dr. Booker T. Washington, a Negro acknowledged as leader of his race, who was head of the school until 1915.

Alabama's Story. Almost 200 years after De Soto's visit, the French established a settlement at Mobile Bay, which later became the city of Mobile. In 1763 the British came into control of the region. In 1783 Alabama came under Spanish rule and, in 1812, the United States seized it. Alabama became a state in 1819, the year Spain relinquished all claim to it. Alabama was one of the leading states in favor of slavery, and was one of the first to secede at the time of the Civil War. The Confederacy located its capital in Montgomery from February to May, 1861. Although there was little actual fighting in Alabama during the war, the state suffered from the reckless legislation and fraud of post-war years. The state ran heavily into debt under this poor government, but thorough reforms were instituted after 1874. The present constitution of the state was adopted in 1901. Four others preceded the present one.

For additional reading consult the following articles:

Appalachian Mountains	Mexico, Gulf of
Coastal Plain	Piedmont Region
Cumberland Mountains	Reconstruction
De Soto, Fernando	Tennessee River

Tennessee Valley Authority



SHRINE OF TEXAS LIBERTY

At the shell-scarred Alamo, formerly the mission of San Antonio de Valero, 187 men preferred to die rather than to surrender their liberty.

AL'ABASTER. Many old vases and ointment and perfume boxes dug up in ruins of ancient houses and palaces are made of a pure white stony substance that can be scratched with a finger nail. This material is alabaster, and it is found in several parts of Europe, particularly in Tuscany, Italy. Modern ornaments such as fine clock stands, vases, pedestals, and statuettes are still made from the better grades of the stone, but it is not used nearly so much as it was in the days of the Romans.

An inferior grade of alabaster is used to make plaster of Paris. The stone is a variety of gypsum, and is composed of tiny grains that make it soft. Sometimes a very white stone is found in odd shapes in caves. This is called *Oriental alabaster*, but it is made of lime instead of gypsum. It is harder than the pure alabaster. The ancients used it for statues and ornamental architecture.

ALADDIN, *a lad' in*. In one of the classic stories of the *Arabian Nights*, a poor Chinese boy, Aladdin, becomes suddenly rich by discovering a wonderful lamp and a charmed ring. All he need do to get anything his heart desires is to rub the lamp or ring; magic slaves appear instantly to obey his commands. With this power, he weds the daughter of the sultan, and has built for her, overnight, a splendid palace. A scheming magician gets the lamp away from her and has its slave whisk the palace into Africa. Aladdin,

however, is more than a match for the villain, for he still has his wonder-working ring! With it, he gets back the lamp and his palace and he and his princess are happy once more. See *ARABIAN NIGHTS*.

ALAMO, *ah' lah mo*. On March 6, 1836, a little band of American pioneers and their wives and children were huddled behind the walls of this old fort in San Antonio, Tex. They had been inside for eleven days, for they were being besieged by 4,000 Mexicans under General Santa Anna, in one of the major battles of the Texan war for independence from Mexico. There were 180 in the fort when the siege started, but many had been killed. The few who remained vowed they would continue to fight, though food and ammunition were running low. Under the command of William B. Travis, and with the encouragement of the pioneers, James Bowie and David Crockett, the little band fought on.

The Alamo had not always been a fort. Once it had been a mission. It had thick walls which stood eight feet high, and it was situated in a small grove of cottonwood trees, which, in the Spanish language, are called *alamo*.

The battle of March 6 raged throughout the day. Finally, only a few were left to surrender, among them the brave "Davy" Crockett. Though they had promised to spare the survivors, the Mexicans who entered the Alamo killed everyone



THE ROMAN LEGIONS FALL BEFORE THE INVADING GOTHs
Alaric I leads his army on to victory and the sack of the Eternal City, Rome.

except a colored boy, two women, and a baby.

News of the fall of the Alamo filled the Texans with indignation. They took up the struggle for independence with renewed zeal, and their battle cry became, "Remember the Alamo!" On April 21, just a few weeks after the massacre, the Texans gained their independence when Colonel Sam Houston overwhelmed the Mexican army under Santa Anna. Texas became a republic, and later the largest state in the Union, but the Alamo was never forgotten. The state has restored the historic old fort in San Antonio, and the people of Texas continue to honor the memory of the little band that held the Alamo.

AL'ARIC I (370?-410). During the decline of the Roman Empire, Italy was invaded by Alaric, leader of the Visigoths, or Western Goths. He besieged Rome three times and sacked it once, in 410.

Alaric was not the type of conqueror, however, that left a path of ruins behind him. The splendid buildings of Greece and Rome suffered little damage during his invasions of Southern Europe. The warriors he left behind him, in Spain, established a Visigothic kingdom there that flourished for three hundred years. See **GOTHs**.

ALARIC II. Unlike most of his Gothic ancestors, Alaric II preferred peace to war. He succeeded his father, Euric, in 485, to become eighth king of the Visigoths. He was an Arian, a member of a sect which held that Jesus Christ was neither truly God nor truly man, and so rejected the doctrine of the Trinity. As a result of this heresy, Alaric was forced to defend himself against Clovis, Christian king of the Franks, who fought for the cause of orthodox Catholicism. Alaric's army was defeated in 507 and he was slain. See **GOTHs**.

AMERICA'S

NORTHLAND
TREASURY

ALASKA. Mysterious land of ice and snow, where the weather was too severe for white men; that is what people in the United States thought of Alaska in 1867. There was profound ignorance of the riches of this great area of 586,400 square miles, a peninsula surrounded by the Arctic Ocean, Bering Sea, and the Pacific.

A "Bargain" Territory. This country was first explored by a Dane, Vitus Bering, who was in the employ of Russia. The first settlement was made in 1784, and fifteen years later the Russian-American Fur Company was organized. The Russians established their government at Sitka. Here they lived in their old-time splendor; Baranof Castle, named in honor of the first governor, was the scene of elaborate parties. In 1867, however, the Russians were glad to sell the lonely territory to the United States for only \$7,200,000.

The purchase was often called "Seward's Folly," because Secretary of State Seward was responsible for what many people thought was a foolish bargain. In a few short years, Alaska proved to be a veritable treasury from which the United States drew millions of dollars in gold and copper, fish, furs, and timber. Each year

Alaska produces more than twice its purchase price, in minerals alone.

The Main Divisions. The mainland territory of Alaska may be divided into three distinct regions: the Pacific coast region, Central Alaska, and the Arctic region. The Pacific coast region, which is the southern part of the country, is mountainous. It enjoys cool summers and rather mild winters. Central Alaska is made up of rolling uplands where the winters are severe, the summers hot, and the rainfall scarce. The typically Arctic northern area, much of which is barren wasteland, has a growing season of less than forty days.

The coastal region is separated from the interior by a series of high mountain ranges. Three of them, the Saint Elias, the Aleutian, and the Alaskan ranges, may be considered a continuation of the coast ranges of the United States and Canada. The Alaskan is the highest mountain range of North America, reaching a height of 20,300 feet above sea level in Mount McKinley. The Brooks range, a continuation of the Rockies, separates the interior region from the Arctic section, the northernmost point of which is only 1,200 miles from the North Pole.

Sub-Arctic Riches. As a result of the warm Japan Current, the sections of Alaska along the Pacific coast enjoy a mild, even climate. The exceedingly heavy rains in this region are caused by the impact of warm, moisture-laden sea air against the cold peaks of the mountain ranges. This heavy precipitation is responsible for the

many glaciers in this region, as well as for heavy forests.

A map of Alaska shows that the state is almost a square, with two long fingers of land pointing to the southwest and southeast. The Aleutian Islands make up the strip that extends 1,200 miles southwest into the Pacific, farther than from New York City to New Orleans. The Panhandle, as the southeastern strip is called, is just about half the length of the Aleutian Islands. Although the summers in the southern coastal region are short, the sun shines about eighteen hours a day during this period. With so much sunshine, the crops mature in a short time. For many years this region has produced choice fruits, especially berries, and potatoes and grain. Efforts continue to develop other crops that thrive in this climate. Since Alaska must import most of its foodstuffs, the cost of living is very high.

In 1935, during the depression, the United States established a homestead project in the Matanuska Valley, south central Alaska, to attract farmers to the region. This is one of Alaska's richest farming areas.

Alaska's Resources. The discovery of gold in 1896 brought a sudden rush of 100,000 prospectors to Alaska. Many of them died of starvation and exposure, many more

returned to their homes disappointed. Others stayed on after the gold fields were worked out, to develop Alaska's other resources, or to trade with the original inhabitants, Indians and Eskimos. Through the years exploration by mining engineers and geologists resulted in finding rich deposits of copper, silver, lead, tin, platinum, antimony, wolfram, coal, oil, and iron.

However, Alaska's most profitable industry has been fishing rather than mining. The state supplies about two thirds of the world's canned salmon. Other fish caught in Alaska's rivers or offshore waters include cod, sole, halibut, herring, smelts, and shellfish. The quick-freezing process has greatly aided the fishing industry. Fur-bearing animals are another commercial resource, with mink, blue and red fox, marten, and seal the most important. A seal herd on Pribilof Island is government owned and protected by the Fish and Wildlife Service. Alaska also has plentiful and varied game. Herds of reindeer, introduced in 1892 as a supplement to the Eskimos' food supply, later were almost killed off. These herds now have been built up and furnish meat and skin products. Alaska's vast forests of spruce, hemlock, fir, and cedar are a source of wealth as cut timber. Mill wastes are the raw material used to produce paperboard and

FISHING — ALASKA'S BIGGEST INDUSTRY

At Port Walter, Alaska, fish are brought into the cannery, and within minutes are processed and sealed in cans ready to be shipped to the world's markets.

M. C. Allen





LINK BETWEEN TWO CONTINENTS

American Indians crossed the Bering Strait in prehistoric times on their emigration from Asia. Alaska was the first stopping place on the new continent.

plastics in the great pulp factories at Sitka and Ketchikan.

Transportation. In the past, speedy reindeer, capable of traveling over 100 miles a day, and teams of northern dogs, called "huskies," offered the only means of land transport. In remote sections of the north dogsleds still are used. Water transport on such great rivers as the Yukon and the Kuskokwim flourished during the few months of the year when the rivers were clear of ice. Some barges continue to ply the state's waterways. Alaska's one railway runs from Fairbanks to Seward. More and more surfaced automobile roads are being constructed to connect mining and industrial areas with the cities. Improvement of the Alaska Highway, about 300 miles of which is in Alaska, invites motorists. Other ways of reaching Alaska are by ship up the beautiful Inland Passage and by airplane. Several major airlines stop at Anchorage on their transpolar flights to Europe.

Statehood. The big event in Alaskan history occurred on January 3, 1959, when President Eisenhower signed the bill which made Alaska the 49th state of the Union. Alaskans had worked for this, but along with their new status go many responsibilities.

The capital, Juneau, remains the same as in territorial days. The other principal cities are Anchorage, Fairbanks, Ketchikan, and Seward. Alaska's population of about 227,000 includes an estimated 16,000 Eskimos and 18,000 Indians. Since World War II, many thousands of U.S. servicemen have been based in Alaska, to man the strategic northern bastions of the defense system. The chief bases are in or near Anchorage.

For further information on Alaska, the following articles may be consulted:

Aleutian Islands
Bering Sea
Eskimo
Kadiak

McKinley, Mount
Pribilof Islands
Seal
Walrus

Yukon River



Albania is isolated from other pro-Soviet states.

ALBANIA, *al ba'ni a*. The little European country of Albania has had a long and troubled history. Successively a part of the old Roman, Byzantine, and Turkish empires, Albania proclaimed her independence in 1912 only to be invaded by foreign powers in World War I. Recognized as an independent state in 1920, she changed from a republic to a monarchy in 1928. Italy invaded Albania in 1939, and the Axis remained in control throughout most of World War II. After the war Albania became a Communist state, closely tied to the Soviet Union.

Albania is situated on the eastern shore of the Adriatic Sea, directly across from Italy. Greece lies to the south and Yugoslavia to the north and east. Albania's area of 10,629 square miles makes it about the size of the American state of Maryland. The country has a population of about 1,200,000. About seven out of ten Albanians are Moslems. Two out of ten are Orthodox Christians, and one in ten is a Roman Catholic. Albanians living north of the Shkumbi River are called Ghegs; those living to the south are called Tosks.

Most Albanians raise crops and livestock, but their country is poorly suited for farming. Inland from the low coastal strip

the land rises in mountains and high plateaus. The chief settlements are found in the interior, especially where valleys and hollows permit farming. Corn and other grains, tobacco, and fruits are grown, and sheep, goats, and cattle are raised. Dairy products, hides, and wool are leading exports. Although Albania has deposits of aluminum, petroleum, and other minerals, the development of these resources has been slow, and there is little industry. The mountain forests are a good source of hard and soft wood. In general, the climate is temperate, with rainy winters and dry summers. The coastal strip has milder weather than the inland regions.

Most of the people of Albania live as their ancestors did, farming with primitive tools, wearing old-time costumes, and remaining loyal to their tribal laws. There are still many who cannot read or write. There are some good roads and modern airports, but railroad construction has been very slow. Few of Albania's rivers can be used for shipping, and while they can provide quantities of water power, hydroelectric plants are lacking. The chief cities are Tiranë (Tirana), the capital, located in the interior; Shkodër (Scutari), in the north; and Korçë (Koritsa), in the southeastern farming region. Durrës (Durrazzo) is the best-equipped port, although Vlonë (Valona) has an outstanding harbor.

Officially a republic, Albania has a government controlled by Communists. But communications are so poor and primitive that many of the people are unaffected by the political system. By following Russia's policies, Albania has made enemies of its neighbors, Yugoslavia and Greece.

ALBANY, N. Y. Despite its distance of 145 miles from New York City and the Atlantic Ocean, this capital of New York state is an ocean port. Foreign vessels steam up the broad Hudson River to its docks, and their cargoes are widely distributed by water, rail, and motor.

The city extends more than four miles along the west bank of the Hudson River.

It prides itself on being the "most distant inland seaport in the United States," and it also connects with Buffalo and the Great Lakes by way of the New York State Barge Canal. The situation of Albany, on the "water-level" route from Chicago, has made it a great railway center. The chief railroads serving the city are the New York Central, the Boston & Albany, and the Delaware & Hudson.

Albany is a city of charm and dignity. The State Capitol, located on Washington Avenue, is one of the most imposing granite buildings in the United States. Standing opposite is the splendid State Education Building, home of the State Department of Education, the State Library, with its excellent collections, and the State Museum.

The Civic Center includes the City Hall, the Court of Appeals Building, the County Court House, and the Joseph Henry Memorial. Historical structures in Albany include the Schuyler Mansion, built in 1762, the Ten Broeck Mansion, erected in 1797, and the building of the Albany Institute and Historical and Art Society.

Notable among the many fine public parks of Albany is Washington Park, covering ninety acres and including a large lake. Many miles of boulevards connect the parks, and there are boat landings on the water front. Albany is an educational center. Institutions of learning include Schools of Law, Medicine, and Pharmacy of Union College, the New York State College for Teachers, the College of St. Rose, and Siena College.

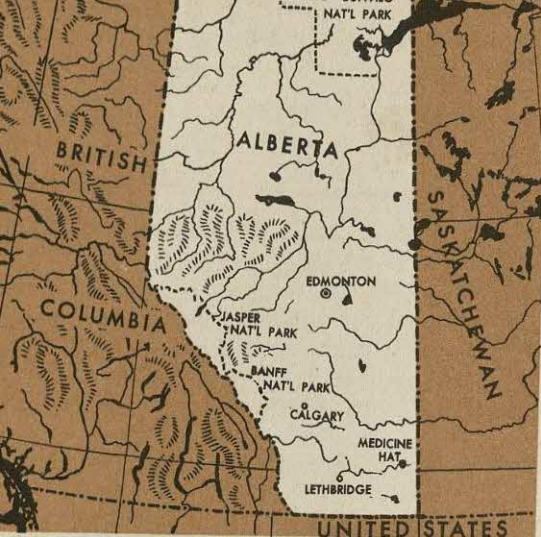
As one of the oldest cities in the United States, Albany is of historic interest. Huguenot refugees from Belgium, known as Dutch Walloons, came to the site in 1624. In 1652 the village they founded merged with a near-by town that had been settled by Hollanders in 1630. When it was transferred to the English, in 1664, the place was named Albany in honor of the Duke of York and Albany, who later ruled England as James II. It became the state capital in 1797. Its population is about 127,000.

ALBANY CONVENTION. In 1754, on the eve of the French and Indian War, a group of Indians and representatives of the American colonies met in the old City Hall in Albany, N. Y. This convention was called at the suggestion of England, and its purpose was to consider how the colonials and their Indian friends could work together to meet the French attack. To this convention came twenty-five delegates from seven colonies and a number of Indians from tribes belonging to the Six Nations. The delegates soon decided that a method of intercolonial union was more important than the Indian question, and they adopted a plan drawn up by Benjamin Franklin.

He proposed that the king appoint a president-general of the colonies, and that the colonies elect a grand council of their own representatives. The council would have control of Indian affairs and have power to levy taxes, enlist and pay soldiers, and build forts. The president-general would have veto power over the acts of the council. This plan suited neither the English government nor the colonies, since each side was afraid of giving the other added powers. Though the Albany Convention failed in its immediate purpose, it pointed the way to a permanent union.

ALBATROSS. Near the Cape of Good Hope and in other southern seas, sailors have often noticed large, web-footed birds following the ships. These are albatrosses, numbered among the largest birds of the sea. Colored grayish-white above, with white bellies, albatrosses measure from ten to fifteen feet between the tips of their outstretched wings. The upper part of the long, straight bill is hooked at the end.

Sailors are superstitious about these birds, and believe bad luck follows when one is killed. The famous poem *Rime of the Ancient Mariner*, by Samuel Coleridge, is founded on this belief. Albatrosses can sleep on the water, and so are able to travel great distances from land. They feed on fish and refuse of the sea, and go to shore only to breed.



ALBERTA — INLAND EMPIRE

The province has about the same area as Texas. It has become a great oil producer.

ALBERT I (1875-1934). As the brave leader of his army in World War I, King Albert of Belgium won the respect of the world and the love of his countrymen for his stand against the invading German forces. This hero king is remembered both for his courage and for his kind treatment of his people.

Albert was the son of Philip, Prince of Saxe-Coburg-Gotha and Count of Flanders. He became king of the Belgians in 1909, when his uncle, Leopold II, died without leaving any sons. Previously, Albert had married Princess Elizabeth of Bavaria. They had three children: Prince Leopold, who succeeded his father as king in 1934; Prince Charles, and Marie-José, who married Prince Humbert, the son of Victor Emmanuel III of Italy. Albert was a second cousin of King George V of Great Britain, and of former Emperor William II of Germany.

Albert was a student of social and economic problems. He traveled extensively, visiting the United States in 1898. After a visit to the Belgian Congo, he brought about reforms in the treatment accorded the natives of that colony. In 1920, while studying trade conditions in the Americas, the king visited the United States with his queen. Albert fell to his death in 1934 while mountain climbing near Namur.

ALBERTA. This western member of the three prairie provinces of Canada is truly an inland empire. Stretching from the United States boundary north about 750 miles, it is nearly as large as Wyoming and California combined; and Alberta is nearly twice as large as England, Scotland, Wales, and Ireland combined. Alberta varies in width from about 400 miles near the center to about 200 miles in the south. Its total area is 225,285 square miles.

Its population stands at about 1,250,000, making Alberta a very sparsely settled province, with only five persons to the square mile. Due to the growth of industry in the towns the population has shifted, and the town dwellers exceed those on the farms.

The Land and Its Resources. Alberta has been called a land of "three provinces in one," for it consists of three distinct physical areas—Southern, Central, and Northern Alberta. Southern Alberta, extending to fifty miles north of Calgary, is chiefly open prairie, except for the foothill country to the west. Central Alberta extends to about 100 miles north of Edmonton, the capital city. Here the vegetation is heavier, the prairie grass longer and coarser, and scrub growth is common. Northern Alberta stretches northward to the sixtieth parallel, which marks the southern tip of Greenland. Here the timber growth is heavier and the grass more abundant.

Along the western border of the province is the great Rocky Mountains barrier, a region of magnificent glaciers, forests, lakes, and snow-clad peaks. Three National Parks are in the Alberta limits of the Canadian Rockies—Banff, Jasper, and Waterton Lakes parks. Highest in the south, the mountains slope gently toward the east; beyond their foothills, Alberta is a part of the great central plain of North America. Generally speaking, the western half of the province has less plain area, heavier rainfall, and more forest growth. The so-called dry areas are for the most part in the eastern half.

Alberta is well supplied with rivers and



Canadian National Railways

LARGEST NATIONAL PARK IN NORTH AMERICA

Jasper National Park (above) is a wildlife sanctuary on the eastern slope of the Canadian Rockies. Its 4,200 square miles include many mountain peaks, lakes, waterfalls, and glaciers. Established in 1907, the park has fine hotels and bungalow camps to house visitors.

has many large lakes. The Peace and Athabaska rivers drain the north, the Saskatchewan system drains the central division, and in the south are smaller rivers connected with the Mississippi system.

Considering Alberta's extent of 750 miles from north to south, we naturally expect to find severe winters in the north, and progressively milder ones farther south. Southern Alberta is in the path of the warm Chinook winds that blow from the mountains. Light snowfall disappears quickly when the Chinook blows. The position of the western mountain barrier has a modifying effect on the province as a whole, and its really attractive climate begins with an early spring.

Though the province as a whole has a rather light annual rainfall, the soils are generally productive and the heaviest rain comes at seeding time. The great open cattle ranches of the early days of Alberta have largely given way to farms operated according to the mixed-farming system of agriculture, or to the great wheat ranches of Southern Alberta. Yet the province is still noted for its beef cattle, horses, sheep, hogs, and poultry. Besides wheat, its leading crops include oats, barley, rye, flax, forage, sugar beets, vegetables, and melons. Huge dams and irrigation projects have greatly increased the productivity of dry Southern Alberta.

After 1947, when an oil well at Leduc, near Edmonton, came gushing in, Alberta rapidly developed into one of the richest, most booming oil and natural-gas fields on earth. Furthermore, under its Rocky Mountain foothills lies one of the world's largest known coal reserves, which supplies a large percentage of Canada's coal.

The lakes of Central and Northern Alberta abound in whitefish, and also furnish pike, pickerel, and trout. The streams of the Rockies are also stocked with fish. Alberta was once the haunt of numberless wild animals and game birds, and is still in many parts a hunter's paradise, but the government protects wild life and there are reservations to conserve such large

game as buffalo, elk, moose, and antelope. The fur trade still flourishes.

Cities and Government. Edmonton, the capital and largest city, is in the center of the province and has some 160,000 residents. Calgary, second in size, lies in the Southwest. The building of new industrial plants and the laying of pipe lines that resulted from Alberta's great oil boom caused many of its cities to mushroom as never before.

Although the Lieutenant-Governor represents the British Crown, actual executive power in Alberta is held by the Premier and his Cabinet, who represent the major party in the provincial legislature. Members of the one-house Assembly are directly elected by the people. The province is represented in Canada's Parliament.

History. The name Alberta was first applied in 1882 to a district of the Northwest Territory. The provinces of Alberta and Saskatchewan were organized in 1905 after the growth of the prairie section, although the Alberta district at that time was what is now the southern half of the province. It is named for Princess Louise Alberta, wife of the Governor-General of Canada and daughter of Queen Victoria. The rest of the province was made up of additions from old Saskatchewan, Assiniboia, and Athabaska.

In 1935 the Social Credit party won control of the provincial government. Although many of its original policies failed to work out, the party remained in power, and its model plan for splitting oil profits between the province and industry proved extremely beneficial to both. See CANADA, DOMINION OF.

ALBU'MEN, or ALBU'MIN. One of the commonest forms of the chemical compound albumen is white of egg, made up of carbon, nitrogen, hydrogen, and oxygen, with a little sulphur. Albumen is also found in the watery part of the blood and in the transparent fluid of the eye. Another variety of it exists in most vegetable juices and many seeds. The meat of the coconut, the flour or meal of cereals, the



THE ALCHEMIST'S QUEST FOR THE "ELIXIR OF LIFE"

Modern chemistry, which is changing our lives so radically today, rose from the fumes of strange brews and mysterious distillations prepared by the medieval alchemist.

horny part of the coffee bean, and the bony substance in the palm nuts which yield vegetable ivory, all contain this widely known compound.

When albumen thickens in any fluid, it readily gathers together and holds other substances which may be floating in the fluid. Therefore, as egg white, it is used in cooking to make syrupy liquids clear. In larger operations, like sugar refining, the watery part or serum of blood is used for clarification. White of egg is a good thing to take in case of poisoning by bichloride of mercury, for it keeps the poison from dissolving into the body fluids. With lime, albumen forms a cement to mend broken ware.

In botany, the name albumen is given to the food supply surrounding the embryo, the part of a seed which forms the future plant. In this case the term has nothing to do with chemical composition.

ALCHEMY, *al'ke me*. Modern chemistry might not be what it is today if the mysterious pursuit of alchemy had not been followed from ancient times down to the eighteenth century. Alchemy is hardly considered a scientific art, but it led to experiments with many chemicals. Its aims were the discovery of a means of prolonging human life and a way to change base metals into gold and silver.

The alchemists attempted to find a substance which would be able to break down all other substances into their elements. This potent material was called the *philosopher's stone*. It was hoped it would also have the power to remove the cause of disease from the human body, and the people who tried to discover it or who claimed to have found it were known as *adepts*.

The Egyptians are believed to be the original alchemists. From them, the art was carried to Arabia, where, in the eighth

century, a school of alchemy issued the first known work on real chemistry. From Arabia, alchemy found its way to Europe, and here were produced the first genuine works on the subject, those by Roger Bacon and Albertus Magnus, written in the thirteenth century.

Another noted alchemist was Thomas Aquinas. Most famous of all was Paracelsus, a Swiss doctor, who did important work in developing the manufacture of drugs. He was followed by Lavoisier, Priestley, and Scheele, who used scientific methods to test the theories of alchemy and so lay the foundations of chemistry. See CHEMISTRY.

AL'COHOL. The strong, pungent taste and penetrating odor of this colorless liquid have been known from antiquity. Today it is important in medicine, in science, and in industry.

One of the most common uses of alcohol in the field of medicine is as a solvent. Many substances will dissolve in alcohol better than in any other liquid. Two examples with which almost everyone is familiar are tincture of iodine, a solution of iodine in alcohol; and spirits of camphor, which is camphor dissolved in alcohol. The anesthetics ether, chloroform, and ethylene are prepared from alcohol. When "denatured" with nonpoisonous substances, it is used as an antiseptic, an astringent, and a counter-irritant.

In the industrial world, alcohol plays a leading role in the manufacture of varnishes, lacquers, paints, resins, perfumes, and soaps. Because of its ability to dissolve many substances it is also used for cleaning and polishing. The specimens in many museums and laboratories are frequently preserved in alcoholic solutions. Alcohol is also used in making plastics, synthetic rubbers, chemicals, and silks, photographic film, dyes, and explosives.

Alcohol occurs in nature through the fermentation of many plant juices, a circumstance which undoubtedly led to the earliest use of alcoholic beverages. It is prepared commercially in a number of

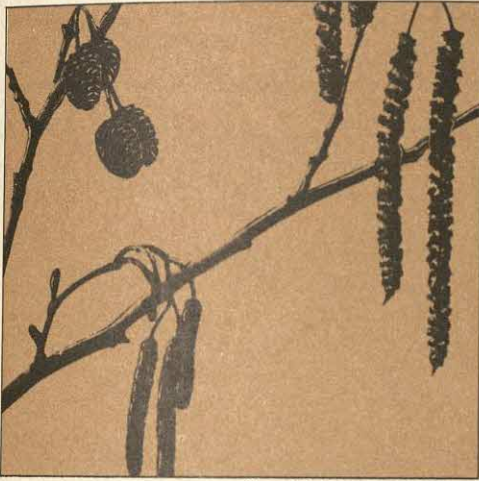
ways. One of the most important is by fermentation of grains like corn, rye, barley, and rice. These grains are allowed to sprout to change the starch in them to sugar. Water and yeast are then added and fermentation turns the sugar to alcohol and carbon-dioxide gas. Potatoes, molasses, sugar, tapioca, and a few other vegetable products may also serve in the making of alcohol. The basic operation is the fermentation, which is the changing of sugars into alcohol.

Alcohol is a clear, colorless liquid, lighter than water. At sea level, it boils at a temperature of 173° F., much below the boiling point of water, which is 212° F. Because of its extremely low freezing point, alcohol is used in thermometers for registering very cold temperatures, far below the freezing point of the mercury in ordinary thermometers. This same property makes it an inexpensive anti-freeze liquid for automobile radiators. Alcohol should always be handled carefully because it is extremely inflammable. Ordinary grain alcohol contains two parts of carbon, six of hydrogen, and one of oxygen.

Denatured Alcohol. Alcohol which has been made unfit for drinking and some other special purposes, by the addition of chemicals, is said to be denatured. This alcohol is used as a fuel or solvent in many manufacturing processes.

AL'COTT, LOUISA MAY (1832-1888). Meg, Jo, Beth, and Amy, the four "Little Women" that almost every young girl has read about, were really Louisa May Alcott and her sisters. Louisa was born in Germantown, Pa., and lived there until the family moved to Concord, Mass., when she was eight. Her father, Amos Bronson Alcott, though a teacher and writer, was never able to provide a good living for his family. Louisa began to send stories to publishers when she was sixteen, and the money that she received for her writings helped pay the family expenses.

She was a lively, energetic young woman, and in 1862, during the Civil War, she served as a volunteer nurse in military hos-



CLOSE-UP OF LIFE ON AN ALDER TWIG

Fruiting cones; early leaf bud on a twig, with spring flowers (left). The full-grown leaves and mature cones (right).

pitals. A collection of letters about her experiences as a nurse, which she wrote to a newspaper, were published in a book, *Hospital Sketches*. It was *Little Women*, however, that made her famous. In this story of the family life in Concord, the lovable and amusing Jo is really Louisa herself. Her other works include *Little Men* and *Jo's Boys*, sequels to *Little Women*; *An Old-Fashioned Girl*, *Eight Cousins*, *Under the Lilacs*, *Jack and Jill*, and *Rose in Bloom*.

Orchard House, in Concord, the old home of the Alcott family, is preserved as a memorial of the children's favorite author.

ALDEN, *awl'den*, JOHN (1599-1687). Prominent among the Pilgrims who sailed to America in the *Mayflower*, in 1620, was a young cooper named John Alden. In the colony of Plymouth, where he was esteemed for his good character and industry, he fell in love with Priscilla Mullens. The story of Alden's wooing, which is one of the popular legends of early colonial days, is known to many through Longfellow's poem, *The Courtship of Miles Standish*.

Captain Standish, a brave man indeed when it came to fighting, lost his courage when he thought of proposing to the lovely

Priscilla. So he asked his good friend John Alden to plead his cause, and John could not refuse, though he loved Priscilla himself. When he asked for her hand, in behalf of his friend, Priscilla demurely replied, "Why don't you speak for yourself, John?"

The marriage of John and Priscilla probably took place in 1622. About nine years later they settled on a homestead in Duxbury, and there they reared their eleven children. John was active in the affairs of the colony, and was an assistant to the governor at various periods until late in life. He lived longer than any other man who signed the *Mayflower Compact*, dying at the age of eighty-eight. Henry W. Longfellow, William C. Bryant, and John Adams were descendants of the Aldens. A house built by John in Duxbury in 1653 is still standing.

ALDER, *awl'dur*. Belonging to the birch family are the alders, interesting and useful trees and shrubs of the temperate and cooler regions of the world. The common, or black, alder of Great Britain, which has been naturalized in the Eastern states, is a shrubby tree that grows well in moist places. Because its wood lasts indefinitely in water, it is in demand for wharf piles and supports of bridges.

The roots and knots of the common alder furnish a beautifully grained wood used by furniture makers, and the bark is valued for tanning and leather dressing. Fishermen use it for staining their nets. The dye, which occurs in shades of yellow and red, becomes black with the addition of iron sulphate. Alder wood is a serviceable fuel, and the charcoal from it is used in making gunpowder.

ALEUTIAN, a lu'shan, ISLANDS. Extending in a broad arc from the Alaskan mainland at the southwest is a string of about 150 islands, the Aleutians. They have a length of 1,200 miles. At their western tip they are nearer to Asia than any other land belonging to the United States. The most westward of the islands has the same longitude as New Zealand, which is near Australia; and they are only a small distance north of the short great-circle ship route to the Orient. The islands are the tops of mountains submerged in the North Pacific Ocean, and they abound in hot springs. The group separates Bering Sea from the Pacific. The largest island is Unimak, which is seventy-five miles long and has a town of the same name.

When the United States bought Alaska from Russia, in 1867, the Aleutian Islands were included in the purchase. In the surrounding waters are rich fishing, sealing, and whaling grounds. The United States maintains naval and air bases on the islands, including Dutch Harbor, on Unalaska, which survived a Japanese attack during World War II. The Japanese seized westerly Attu and Kiska in 1942 but were routed by American troops in 1943.

The Aleuts, who live on the islands and in parts of Alaska, are a branch of the Eskimo people. They live chiefly by fishing, trapping, hunting, and a little farming. The women weave beautiful baskets. During World War II, American ships moved the islanders to the safer mainland. See ALASKA; ESKIMO.

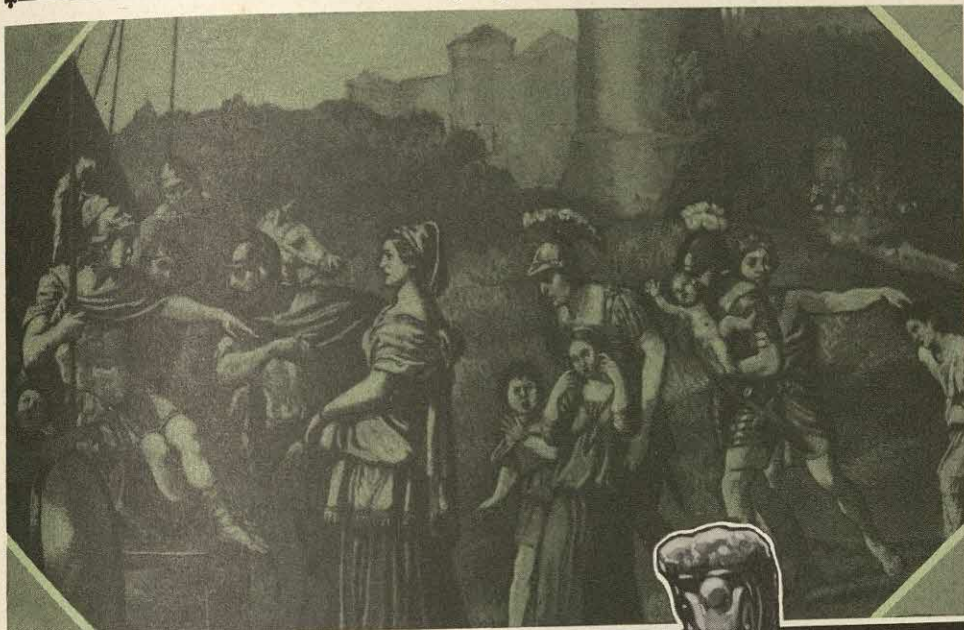
ALEWIFE. Important among the food fishes of the eastern coast of North America is the alewife, a small fish not over two

pounds in weight and less than a foot long. It is found in large numbers between the Saint Lawrence River and the Carolinas. During the month of April great numbers of alewives ascend fresh-water rivers to spawn, or deposit their eggs; from 60,000 to 100,000 eggs are laid by each female, but a great many of these are eaten by fish, and the number of alewives is said to be decreasing. The alewife looks like the shad in color and shape, and is related to that fish and to the herring. See HERRING; SHAD.

ALEXAN'DER. Between the second and the seventeenth centuries, eight men with the title of Alexander held the office of Pope, head of the Roman Catholic Church.

Alexander VI (1431-1503) was the most famous of these Popes. His real name was Rodrigo Borgia. Although in his early youth he had both the good and bad manners of his time, he was recognized for his ability and became a cardinal at the age of twenty-five. When Innocent VIII died, in 1492, Rodrigo was elected Pope. Among others of his undertakings, he succeeded in lessening the power of the Italian princes and in increasing the Papal income. Historical events of his reign include the introduction of the *Index Librorum Prohibitorum* (index of prohibited books), the execution of Savonarola, the fiery religious reformer, and the division of the New World between Portugal and Spain. See BORGIA; DEMARCATION, LINE OF.

ALEXANDER THE GREAT (356-323 B. C.). At intervals in the long march of time a great world figure appears — a man who, by force of character and by virtue of his deeds, changes the course of history. Such a man was Alexander the Great. He was the son of Philip of Macedon, ruler of a powerful kingdom to the north of Greece. His mother, Olympias, a princess of the neighboring state of Epirus, was a woman of intense emotions and vivid imagination. In the character of Alexander the Great we see the union of two strong personalities, for from each of his



parents he inherited notable traits. Organizing ability, the spirit of enterprise, lofty ideals of world unity, and a vision of personal grandeur combined to make him one of the most impressive figures on the pages of history.

Days of Youth. When his son was thirteen, Alexander's father placed the young prince under the tutorship of the Greek philosopher Aristotle. The boy's artistic sense awakened to the beauty of Greek literature and to the inspiration of classic mythology, and he came to believe that he was in truth a descendant of the mighty Hercules. The trained, logical mind of Aristotle led him to see the value of organized science, and his whole nature expanded under the instruction of the wisest man of the age. Aristotle's influence on the receptive, eager youth cannot be overestimated.

Alexander, too, was thrilled by the ambitious plans of his father, intent on gaining the mastery of the Greek states and on uniting them so that they could present an unbroken front against their common enemy, the Persians. Philip had first to bring the resentful Greek states under control; according to legend, as Prince



ALEXANDER THE GREAT WORLD CONQUEROR

Alexander the Great (top) inspects his captives after the sack of Thebes. The heroic statue of the youthful conqueror (below) is now in a museum at Rome.

Alexander stood by one day, watching the Macedonian army march to war, he wept for fear his father would leave no worlds for him to conquer. The youth was permitted to accompany his father on the expedition to Boeotia, in Central Greece, and in the Battle of Chaeronea (338 B. C.), he proved to be a good fighter at this final stand of the Greek states.

King and Conqueror. Two years later, in 336 B. C., Philip was stabbed to death by one of the nobles of his court. Alexander, then but twenty years old, acted vigorously to punish his father's murderer and his fellow conspirators, and also put to death Philip's second wife and infant son. The young king began his reign under trying conditions. He had to subdue rebellious cities of Greece and to quiet hostile tribes beyond the northern frontier of Macedonia.

While he was absent in Thrace, it was reported that he had been slain. The Thebans rose in revolt and were joined by the Athenians. Determined to quell the Greek city states once and for all time, Alexander took the city of Thebes by surprise, destroyed all the buildings except the temple and the house of Pindar, the poet, and sold the people into slavery. This severe lesson taught the Greek states that they had a real master, and thereafter they submitted to him.

The March Eastward. The next goal in Alexander's ambitious plans was the conquest of the Persian Empire. In the spring of 334 B. C., he set out with an army of 35,000 men, beginning one of the greatest continuous marches in history. His forces crossed the Hellespont and overwhelmed a Persian army at the Granicus River, achieving a victory that removed the barrier to all of Asia Minor. From the Granicus River Alexander moved northward to Phrygia, where he spent the winter. In each city that he conquered, he left behind Macedonian governors and garrisons of soldiers, for it was now his determination to make the whole world Greek.

The next year (333 B. C.) he started south from Phrygia toward Syria. At Issus he led his trained cavalry in person, defeating the hordes of Persians under the command of their king, Darius III. Disdaining the latter's offers of peace, Alexander proceeded to the conquest of Phoenicia and Syria. The famous city of Tyre resisted him for seven months, but was finally taken after a terrible siege. Eight thousand Tyrians were slain, and the remaining 30,000 were sold as slaves. The other cities of Palestine and Philistia, except Gaza, did not resist. The siege of Gaza lasted only two months, and after it fell its citizens also were sold into slavery.

Of all the Persian provinces on the Mediterranean, Egypt alone remained to be conquered, but no conquest was needed. The Egyptians welcomed Alexander as a deliverer, and at one of the mouths of the Nile he founded a city that became famous as the Egyptian Alexandria. Stirred to high emotion by this succession of triumphs, Alexander proceeded to the Temple of Ammon in the Libyan Desert, where he heard himself called a son of Zeus. Well did he know that the Eastern peoples would not recognize him as a king unless he claimed descent from the gods.

Persia Conquered. Alexander now turned his army eastward to complete the subjugation of the Persian Empire. Darius III had gathered together another army of more than a million men, and in 331 B. C. the Persians and Macedonians met at Arbela, near the ruins of ancient Nineveh. At Arbela, Alexander was a victor in one of the decisive battles of the world, for it marked the triumph of Western civilization over Oriental despotism.

From Arbela he hurried to Babylon and Susa. These cities threw open their gates to him without making any attempt at defense. At Persepolis, the capital of Persia, Alexander seized the royal treasures of silver and gold, burned the royal palace, and massacred or made slaves of all the inhabitants. In this manner he became the visible ruler of Persia.

After the Battle of Arbela, Darius fled eastward with Alexander in pursuit. Bessus, a cousin of Darius, murdered the Persian king and set himself up as ruler, but Alexander followed him through Northern Parthia into Bactria, where he captured and executed him.

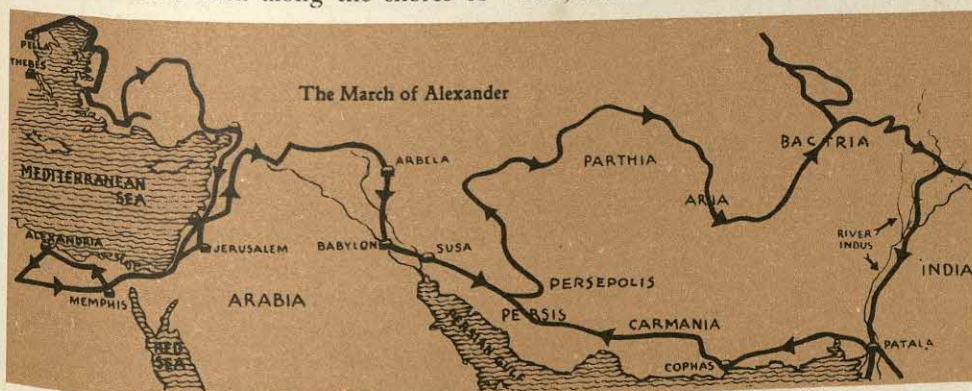
The Far East. Supreme master of the once powerful Persian Empire, Alexander, at the age of twenty-six, began a new campaign to add India to his vast realm. For six years, from 330 to 324 B. C., he and his faithful battle-worn soldiers marched eastward. They conquered barbaric tribes along the Caspian Sea, forded rivers and breasted high mountain passes, crossing the frontiers of India in 327 B. C. The peoples and rulers of that great land were easy prey, but when Alexander announced his plan of pressing forward to the Ganges, his veterans could bear no more.

There was dissatisfaction, too, with the conqueror's adoption of Oriental customs. He himself married the daughter of Darius and urged his followers to take Asiatic wives. Not content with bringing Greek culture to the East, he assumed the outward trappings of an Oriental monarch who was to be obeyed without question and revered as a god. Alexander's friend Clitus, who had once saved his life, bitterly reproached his master for this policy, while at a royal banquet, and was stabbed to death by the hot-tempered ruler.

The March Back. Unable to cope with the rebellious spirit of his soldiers, Alexander led them back along the shores of

the Indian Ocean, and in 323 B. C. reached the city of Babylon, which was to be the capital of his widespread empire. The conquest of the Arabian peninsula was the next step in his plan to complete the union of the East and the West, but before he could organize the new campaign, he fell ill of a fever and died. Years of incessant fighting and marching, of exposure to varying climates and to Oriental diseases, as well as dissipation and excesses, had taken their toll. Thus perished the greatest figure of his time, at the age of thirty-three.

As History Judges Him. Whatever his personal faults, no historical character more truly deserves the title "Great" than this young Macedonian king. Cities called Alexandria in his honor were founded along the line of his march, and the best of Greek art, commerce, and science was diffused throughout the East, even to China. His vision of a world family of nations, unknown before his time, was a tremendous stimulus to international trade. His interest in science never waned throughout his career of conquest, and during those years his collectors of natural history sent innumerable specimens back to Aristotle for identification and classification. It was a tragedy that death removed him before he was able to consolidate his vast empire as a political unit. With his death it fell to pieces, but his influence on civilization was a permanent thing. See ALEXANDRIA; ALEXANDRIAN AGE; ALEXANDRIAN LIBRARY.





THE PHAROS LIGHTHOUSE—SEVENTH WONDER OF THE ANCIENT WORLD

ALEXANDRIA, EGYPT. Ancient Alexandria, situated on the western delta of the Nile River, was one of the greatest and richest cities of the world in the third century B.C. Founded in 331 B.C. by the Macedonian conqueror, Alexander the Great, and named for him, it became the center of commerce on the Mediterranean Sea, which was then surrounded by the only civilized countries in that part of the world.

At the height of its prosperity the city had a population of about 1,000,000, and it was noted for the many Greek artists and scholars who resided there. After Alexander's death, Ptolemy Soter, one of his generals, founded the great Alexandrian library. During the time of the Greeks, the island of Pharos, on which part of the city was built, had a gigantic lighthouse which was one of the Seven Wonders of the Ancient World.

Alexandria continued to be a great commercial city when the Romans came into power; it was, in fact, second only to Rome. In the year 641, however, it was captured by the Arabs and then began to decline in importance. When the Cape of Good Hope was discovered, leading to a new route to India, the commerce that Alexandria had enjoyed with the East vanished, and the once great center of culture and trade became hardly more than a village.

At the beginning of the nineteenth century, Alexandria was an unimportant town of about 5,000 or 6,000 people. Dur-

ing the course of the century it began to regain some of its trade, and when the British took over the jurisdiction of the city, in 1882, it entered upon a new era of prosperity.

The present city is divided into two parts. Mohammedans live in one section, Europeans live in the other. In the European section are found all the finest hotels, cafes, and office buildings. This section is supplied with gas, and drinking water is brought from the Nile by the Mahmudieh Canal. Railroads connect the city with Cairo, Rosetta, and the Suez Canal. Catacombs lie to the south. There are two ports, through which pass great shipments of goods. The University of Alexandria was founded in 1943 as the University of Farouk I, and was given its present name in 1953. The population of Alexandria is about 1,400,000. See EGYPT.

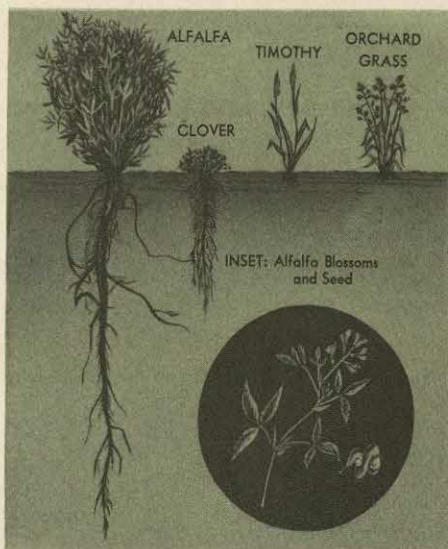
ALEXANDRIAN AGE. For several centuries after the death of Alexander the Great, 323 B.C., the city of Alexandria was a center of Greek literature and learning. This period of Greek culture is known as the Alexandrian Age. The first king of the Ptolemaic dynasty, Ptolemy Soter, founded the great Alexandrian Library, which became the storehouse of the finest literature of antiquity. Among the famous scholars whose learning enriched the age were Euclid, the father of scientific geometry; Archimedes, the physicist; and Ptolemy, astronomer and geographer. Poetry and philosophy also flourished. See ALEXANDRIA; ALEXANDRIAN LIBRARY.

ALEXANDRIAN LIBRARY. This famous library of the ancient world was founded in the city of Alexandria, Egypt, in the period following the death of Alexander the Great. Planned by Ptolemy Soter, king of Egypt from 323 to 283 B. C., it was enlarged by succeeding rulers until it was said to contain 700,000 volumes. The main library was originally located in a beautifully landscaped park containing also the Royal Museum.

The "volumes" in the library were not like the printed books of today. They were rolls of papyrus, an Egyptian water plant. Layers of the stems were gummed and pressed together, to form a smooth mat. Then the sheets were glued end to end and formed into rolls. After the material was written on, it had to be dried by fanning or sprinkling with sand. When used for reference, these "books" were laboriously rolled back and forth.

A system of cataloguing and regulating the great collection was devised, a task given to a group of scholars under a chief librarian. The first librarian was Zenodotus of Ephesus, but the actual cataloguing of rolls was made by Callimachus, the famous poet and philosopher. He listed the titles and authors of all the works, classifying them as historians, orators, etc. The first catalogue filled 120 sections. It was the king's order that every time a strange book was brought into the city, it was to be copied for the library. Thus a large staff of copyists was hired, and their copies came to be recognized as the standard works.

Most of the valuable rolls of this great library were burned when Alexandria was invaded by the Romans under Julius Caesar, in 47 B. C. A smaller collection was preserved in the temple to the Egyptian god Serapis, located probably in a western suburb. In 391, during an invasion of the Christians, the temple and its contents were destroyed, and the greatest library of antiquity was lost to civilization. The only manuscripts surviving are copies of copies made from its rolls.



ALFALFA. This plant, which looks like clover and belongs to the same family, is one of the most important sources of hay and pasturage. Farmers in many parts of the world are raising more of it, year by year, because of its value as a nutritious feed for nearly all farm animals. There are several different varieties of alfalfa. Some do well in cool, humid climates, and others resist heat and drought. Some thrive in lowlands, and others a mile above the sea. In general, alfalfa requires a non-acid soil, rich in nitrogen, deep, and well drained. Weeds are harmful to the growing plants because their roots rob the soil of nourishment. The best alfalfa yields are obtained in regions with dry atmospheres and mild growing seasons.

Besides being used as feed for beef and dairy cattle, sheep, hogs, horses, and poultry, alfalfa is used for producing honey. Its flowers, which are purplish or some shade of yellow, depending upon the variety, are particularly attractive to bees. Alfalfa is sometimes ground and sent to market as meal, and it is a major commercial source of chlorophyll. But it is as fodder for farm animals that alfalfa is most widely used.

In the United States alfalfa is the most valuable forage crop grown, and

millions of tons are produced yearly. It is raised in all parts of the country, but most of it comes from the North Central and Western states, including California, Iowa, Minnesota, Wisconsin, Idaho, and Michigan. It is also a leading forage crop in Canada, where Ontario is the leading producer, and in Latin America, the Soviet Union, the Near East, India, and Australia. In Europe it is called *lucerne*.

Believed to be a native of Southwest Asia, alfalfa is probably the oldest of all forage crops. It has been grown by man since prehistoric times. Its name comes from the Arabian *alfisfisah*, meaning *best fodder*. Spanish explorers brought it to the New World, but the seeds carried to California from Chile by gold-seekers traveling around Cape Horn in the 1850's really started alfalfa-growing in the United States.

The roots of alfalfa reach a depth of from ten to twenty feet, while above ground the plant stands one and a half or two feet tall. It grows rapidly and can be harvested within forty days after being planted. Under favorable conditions farmers can harvest as many as eight crops a year. Alfalfa enriches the soil with nitrogen from the air; but for it to do this, the soil must contain certain *nitrogen-fixing* bacteria, which form nodules on the roots and provide the plants with nitrogen. If the soil contains none of these, the bacteria must be added. Alfalfa hay is cut when the flowers begin to bloom or when young shoots from the crowns of the plants are about two inches tall. See also **LEGUMINOUS PLANTS**.

ALFONSO XIII (1886-1941). When the United States and Spain were fighting the Spanish-American War, a twelve-year-old boy was king of Spain. This was Alfonso XIII. He saw his country through a period of unrest and disorder, and then was sent into exile, perhaps to be the last of the kings of Spain. Alfonso was the son of Alfonso XII, who died before the boy was born. During his youth, his mother, Maria Christina, acted as ruler.

Alfonso XIII began to reign in his own right in 1902. Four years later he married Princess Ena of Battenberg, a granddaughter of Queen Victoria of England and first cousin of Emperor William II of Germany.

Following World War I, conditions in Spain grew so confused that in 1923 the king permitted General Primo de Rivera to rule as dictator. In 1930 he was replaced by General Berenguer, but a year later the Spanish people overthrew the monarchy and set up a republic. The king, sentenced to perpetual exile, went to Rome. There he died in 1941, after renouncing the throne in favor of his son Don Juan, who may never rule. See **SPAIN**.

ALFRED THE GREAT (849-901). Centuries before England became the great power she is today, the country was constantly being menaced by invaders. In the ninth century, when the Danes attempted to conquer the land, the West Saxons were ruled by Alfred the Great, a wise and brave king who is remembered today for uniting the different provinces of England and for the liberal laws and the literature he gave his people.

Alfred was the youngest son of Ethelwulf, who reigned from 836 to 858. Alfred's three older brothers ruled after his father died, and he came to the throne in 871. When he became king, the country was in desperate condition, and for a time it appeared that the Danes, sailing across from their native country, would seize the entire land. Alfred first attempted to make peace with them, but they refused his offers and began to sack the country.

In 878 Alfred was defeated, and he took refuge in the marshes of Somerset. A short time later, however, he overwhelmed the enemy at Edington and peace came to England. It was during his sojourn in the marshes (according to legend) that Alfred, disguised as a weary traveler, found shelter in the house of a peasant woman. She set him to watch her hearth-baked cakes, but he let them burn, and was loudly scolded.



"MUSIC HATH CHARMS—" ALFRED THE GREAT BEGUILLES THE DANES

The heroic English king is shown in the camp of his mortal enemy, Guthrum, the Danish chief. Legend has it that Alfred disguised himself as a musician, and entertained the Danes with the songs of merry England. This is only one of many myths which have grown up around Alfred, but it is no legend that he drove the Dane from England.

At this time, Alfred ruled over most of the country, and he wished to have his people taught to read, so that they might enjoy life more. He brought many artists and scholars to his court. Old books were translated into Anglo-Saxon, some of them being Bede's *Ecclesiastical History of England*, Gregory's *Pastoral Rule*, and Boethius's *Consolations of Philosophy*. Alfred himself wrote many of the books in Anglo-Saxon, the language of the times, changing them from Latin, which only a few people then understood. He revised and added to a valuable history of the times, called the *Anglo-Saxon Chronicle*.

Besides contributing so much to the education of England, Alfred built many forts and placed soldiers throughout the land to enforce the laws and preserve peace. Many of the old laws were changed by him, some of them becoming the foundation for the laws of modern England.

It is said that Alfred was far in advance of his times, for in those days it was the custom of kings to be cruel and to care little about the people they ruled. Alfred, however, loved his people, and it was his achievements in their behalf that earned for him the title "Great."

ALGAE, *al'je*. Seaweeds, the green scum on stagnant water, and slime on rocks found in ponds, are all forms of algae, a subdivision in the plant world. Seaweed was once believed to be useless, but when it was found to be a source of iodine, it quickly became a commercial product. For a long time, all the iodine produced was made from several kinds of seaweed. Some forms of algae, like carrageen, Irish moss, and dulse, are used as food. Other kinds are used as fertilizer.

There are about 20,000 species of algae, classified according to their color. Most green algae are found in fresh water, while the brown and red types grow in salt water. Some forms of algae have stems which have their roots attached to rocks. Other kinds have no stems. In size they range from forms that can be seen only through a microscope to those many feet

in length. In the classification of the plant world, algae rank next above bacteria, the simplest plant forms.

AL'GEBRA. This branch of mathematics follows the elements of arithmetic. It might be called a study of the "sign language" of mathematics. In algebra, letters and other easy symbols are substituted for numbers, with the result that mathematicians all over the world can easily understand each other's methods and results. The convenience of algebraic methods and expressions has made them a basis for all higher branches of mathematics.

To illustrate an algebraic expression: It has been shown that the *Area of a triangle* is equal to *one-half the length of the base of the triangle multiplied by the height*. Algebra simplifies this statement to read:

$$A = \frac{1}{2}bh.$$

Applying numbers to a triangle, if the base is 6 inches and the height 3 inches, the area is 9 square inches:

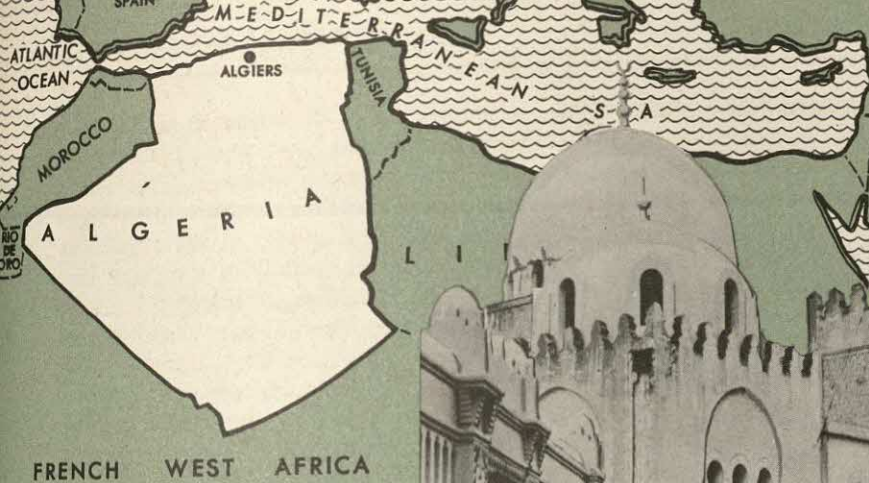
$$A = \frac{1}{2} \times 6 \times 3 = 9.$$

This problem shows how algebra simplifies mathematical relationships.

Algebra is often fascinating to the first-year high-school student who is studying its fundamentals. An enormous field of interest lies before him and he begins to realize how necessary algebra is to any knowledge of mathematics. For its methods can be applied to almost every type of problem both in the exact sciences and in business.

One of the advantages of algebra is that it gets its results quickly and accurately. This advantage is important, because speed and accuracy are at a premium in modern life. Another advantage is that constant practice in algebra, with its precise and logical methods, often develops a greater degree of care and logic in all the student's thoughts and actions.

These advantages have been recognized since before 1700 B. C., when the Egyptians are known to have been acquainted with algebra. Nevertheless, it is probable that, because of many improvements in teach-



ing methods, the high-school freshman of today knows as much algebra as the wisest of the Egyptians had mastered 4,000 years ago. The Greeks and Arabians are responsible for most of the development of algebra until the thirteenth century, when it was brought into Europe as a science by Leonardo of Pisa, Italian mathematician. It assumed its present form about the sixteenth century. See ARITHMETIC.

ALGERIA, *al je'ri a*. Romantic stories picture this North African country as a vast, hot desert, inhabited by wandering, long-robed Arab herdsmen and policed by the hardy soldiers of the French Foreign Legion. To the countless tourists who have enjoyed the sunny, mild winters of picturesque Algiers, the capital, chief seaport, and largest city, Algeria is a delightful vacation spot, with a climate similar to that of the French Riviera. Although both ideas are partly correct, Algeria is far more. Even before the birth of Christ, when it was the Roman province of Numidia, wheat from its fertile fields helped to feed Rome. Today it is a great source of raw materials for world markets and especially for France, which has held political power there since 1830.

Farming and livestock-raising are still the chief occupations. Leading crops in-

clude winter wheat, barley, oats, and corn; potatoes, artichokes, and other vegetables; tobacco, flax, and alfalfa. From Algeria's fine vineyards come grapes for making excellent wines; its rapidly increasing orchards and groves furnish olives, citrus fruits, figs, pomegranates, almonds, and some of the world's best dates. Large numbers of cattle, sheep, goats, mules, asses, and camels are raised, and wool, hides, and skins are important products.

Algeria's forests supply large quantities of cork and timber. From the Mediterranean, which borders the country on the north, come coral, sponges, and fish. The country is a top supplier of phosphate rock and also produces iron ore, zinc, lead, mercury, copper, antimony, tin, salt, and some oil and coal.

For centuries Algeria has been noted for its hand-woven rugs and fancy leather

French Embassy Press & Information Division

ALGERIA: CROSSROADS OF CULTURES

Europe and Africa, Christianity and Mohammedanism, meet and mingle in the North African country of Algeria, strategically located on the Mediterranean coast. Above is a Moslem school in Algiers.

goods. Its other industries include oil-refining, distilling, flour-milling, and the making of olive oil, tobacco products, silks, matches, and paper pulp.

Algeria is more than three times the size of Texas. It covers 852,600 square miles. The population of about 10,300,000 consists mostly of Arabs and Berbers of Moslem faith. About fifteen per cent of the residents are Christians of European, chiefly French, birth or descent, or members of a sizable, long-established Jewish group which has played an important part in the country's development. These last two groups own most of the industries and better farmlands. Many of the Algerians who work for them have had little opportunity for schooling.

Some seven eighths of the people live in the northern tenth of the country. Here, along the coast, is the Tell, the narrow belt containing most of Algeria's fertile lands, cities, railways, airports, modern roads, dams, and irrigation projects.

Southern Algeria, which reaches down into the desolate Sahara Desert, has no defined border but simply merges with French West Africa on the south. Its few inhabitants are roaming, tent-dwelling Arabs and natives living in small oases settlements, where dates are the chief crop. The plateau and the two ranges of the Atlas Mountains are thinly settled areas separating the Tell from the Sahara.

History. Throughout the centuries Algeria has been held by the Phoenicians, Carthaginians, Romans, Vandals, Byzantines, Spaniards, Turks, and French. For centuries before 1830 it was one of the Barbary States (see **BARBARY**). France took control of Algeria in 1847. Algeria was an Allied base in World War II. The Algerians began a fight for their independence in 1954.

Government. Algeria is governed by a delegate general appointed by the Premier of France. Algeria consists of fifteen departments plus two Sahara departments. Seventy-one Deputies and thirty-four Senators are elected to sit in the French Parlia-

ment at Paris. Two thirds of the Deputies must be Moslems.

See also **AFRICA**; **ALGIERS**; **BERBERS**; **SAHARA**; **WORLD WAR II**.

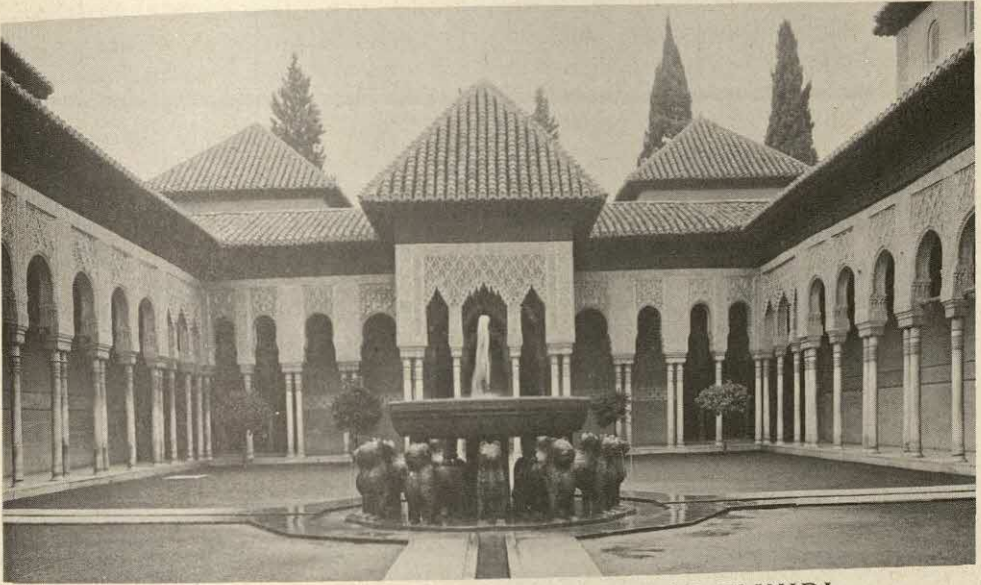
ALGIERS, *al jeerz'*, **ALGERIA**. A "shining city" of white buildings gleaming in the brilliant sunshine, Algiers, the capital of Algeria, lies on the shore of the Bay of Algiers, an arm of the Mediterranean. The city spreads up the bordering hillsides to the *Casbah*, the highest, oldest section. In contrast to this crowded Moorish quarter is the lower, thoroughly modern European section. The city is a great seaport, with excellent rail, highway, and air transportation. The fine climate attracts many visitors. Built in 944, it served as headquarters of the Free French government during part of World War II. The population is about 361,000.

ALGONQUIAN, *al gong'ki an*, **INDIANS**. When the American colonists landed in New England, they found a peaceful tribe of Indians living there. This tribe belonged to the largest group of Indians in North America, the Algonquians. They were so numerous that their homes and hunting grounds reached from Labrador southwest to the Carolinas and Tennessee, and from the Atlantic west to the Rocky Mountains.

The Algonquians did not like the colonists because these white invaders were taking the land for themselves. Forced to move westward, the Indians fought fiercely at every step. From 1689 to 1763, they waged unceasing war against the English, as in the French and Indian War, when the Algonquians allied themselves with the French. Finally, in 1765, Pontiac, chief of the Ottawas, agreed to a peace treaty with the English.

The Algonquians were eventually confined to scattered reservations west of the Mississippi River. Today there are about 90,000; the majority are in Canada.

The Algonquians were not like the roving Indian tribes. They lived in permanent homes of bark and logs. They cultivated the soil, and raised corn. Among



COURT OF THE LIONS AT ALHAMBRA CASTLE, GRANADA

One of Spain's most famous Moorish structures, the castle was completed about 1354.

the chief Algonquian tribes were the Narraganset, Pequot, Delaware, Ottawa, Ojibwa, Illinois, Kickapoo, Potawatomi, and Cheyenne.

ALHAM'BRA. Standing on a high and beautiful hill in Granada, a city of Spain, this former fortress and palace has always been recognized as one of the finest examples of the art of the Moors, who once inhabited the country. The word means *red castle*, and it was there that the Moorish kings lived and held court. It is a huge structure, and is surrounded by a wall two and a quarter miles long.

The Alhambra was begun in the year 1248, and was captured by Ferdinand and Isabella, the rulers of Spain, in 1492, when the Moors were driven out of the country. Throughout the years it has suffered much from fire and wars, but it is still a beautiful building, and many artists and architects travel to Spain to study it. Many of the stories of the old citadel are contained in a book by Washington Irving, called *The Alhambra*.

ALIEN, ail'yen, AND SEDITION LAWS. In 1798, when John Adams was President, Congress passed a series of laws

giving the President power to order aliens (unnaturalized foreigners) out of the country if they were suspected of political activity. At the same time, laws were passed authorizing fines and imprisonment for persons who published scandalous statements about Congress or the President.

Called the Alien and Sedition Laws, they had as their chief aim the defeat of Thomas Jefferson, then a presidential candidate, who was supported by many foreign writers and speakers living in the United States. In the next election, the Federalists, who were responsible for the unpopular laws, were swept out of office forever. Under President Jefferson the laws were repealed.

ALIMENTARY CANAL. One of the principal sections of that marvelous machine, the human body, is the alimentary canal. This is the department which takes charge of everything that goes into the human mouth and either changes the food into energy or discards it as waste. In the average man, this canal is about thirty feet long, extending from the mouth through the stomach and the large and

small intestines. The various juices in the passage act on usable parts of the different foods in a chemical way, to change them into nourishing fluids which can be absorbed by the canal lining. See **INTESTINES**; **STOMACH**; **DIGESTION**.

AL'KALI. In pioneer days, it used to be part of the wife's duty to soak wood ashes from the hearth in water, drain the liquid off, and boil it with home-rendered fat to make the household supply of soap. All of this work was a primitive method of using an alkali, in this case, potash or lye. Alkalies are basic chemical substances, just the opposite of acids; they may be strong or weak, but they never fail to go into action when they meet an acid, usually taking some part of the acid into combination to form a new substance, or salt. The wood-ash brew used by the pioneer woman was essentially lye (potassium or sodium hydroxide), and it combined with the hot lard or drippings (largely stearic acid) to make the "salt" soap.

In chemistry, alkalies include all substances showing the following reactions in common: they dissolve in water; neutralize acids and form salts; eat into animal or vegetable matter (like lye making holes in cloth); turn certain dyes blue, as litmus, a standard testing chemical. (Acids turn the same dyes red.)

Alkaline soils such as are typical of areas in the Western United States will not grow crops unless properly neutralized by the addition of chemicals.

AL'KALOID. In the chemical world, certain compounds are grouped together in "families" because they resemble each other in a number of ways. The alkaloids are such a family. They all combine with acids to form salts and are therefore known as *bases*.

In a few of their properties, they differ radically. Some of them are deadly poisons. Conine, an alkaloid found in hemlock, was the poison Socrates drank when he was sentenced to death. Still other alkaloids, like quinine, are important medicines, and some are powerful anesthetics.

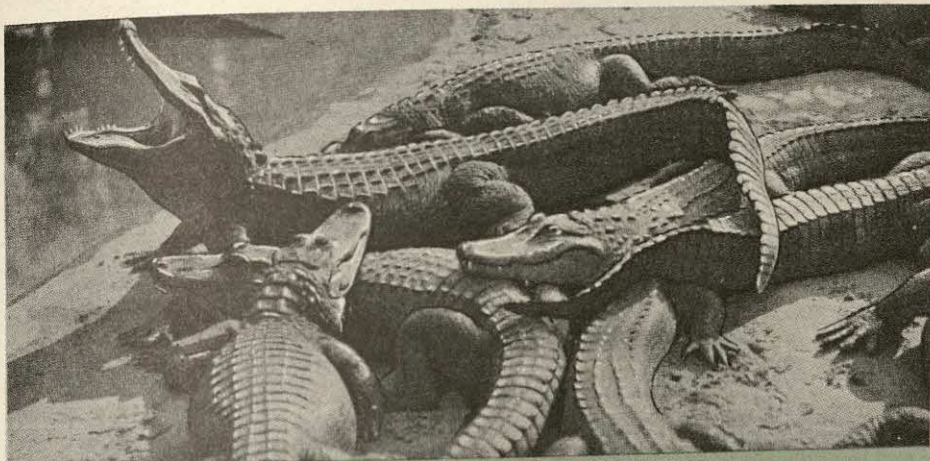
Alkaloids are found in living plants, usually in combination with other substances. The names of alkaloids usually end in *ine*, as morphine, atropine, caffeine, codeine. Most natural alkaloids contain carbon, hydrogen, nitrogen, and oxygen. When oxygen is lacking, the alkaloid is liquid in form. See **ANESTHETIC**.

AL'LAH. Millions of persons of the Mohammedan faith worship *Allah*, their God. The word is Arabic and is akin to the Hebrew *Elohim*. "Allah Akbar" (God is great) is the war cry of the Mohammedans.

ALLEGHENY, al'le ga ne, MOUNTAINS. That beautiful central section of the Appalachian Mountain range which runs through Pennsylvania, West Virginia, Maryland, and Virginia inherits the old Indian name, Allegheny. Between its thickly wooded slopes lie fertile valleys, dotted with farm and village. Here also are busy industrial cities, for the Alleghenies are rich in high-grade coal and other minerals.

Low in comparison with the Rockies, or the coast ranges of the West, the Allegheny series of parallel ridges average about 2,500 feet above sea level, although in Virginia they attain heights of over 4,000 feet. They rise abruptly on the east, to form the "Allegheny front." On the west, the slope is more gradual and takes in a large area sometimes called the Allegheny plateau. See **BLUE RIDGE**; **APPALACHIAN MOUNTAINS**.

AL'LEN, ETHAN (1737-1789). When the battles of Lexington and Concord signaled the start of the Revolutionary War, Fort Ticonderoga, on Lake George in the Adirondack Mountains, was an important British outpost. Ethan Allen, born in Connecticut, had settled near Bennington, Vt., by 1763. At that time, New York claimed Vermont's territory and Allen became leader of the Green Mountain Boys, organized to drive New York settlers out. Allen and Benedict Arnold, who was afterwards to turn traitor, set out to capture the fort.



THESE ARE NO FAIRY-TALE MONSTERS

They are American alligators, the long-tailed and short-tempered denizens of Southern swamps. Among the largest of reptiles, they grow to a length of about sixteen feet.

Both wanted the honor of taking it, and Allen won. Reaching the shores of Lake George on May 10, 1775, he immediately set out across the lake to the fort. The dashing Allen did not wait for all his men to cross, but marched into the fort with a handful of soldiers and ordered the commander to surrender, "in the name of the Great Jehovah and the Continental Congress." The commander yielded and Fort Ticonderoga fell to the Americans.

Allen later went to Philadelphia, then the capital of the new nation, where he was honored by the Continental Congress. He was sent to Canada to see if that country would join the Americans and there he was captured by the British. Allen was taken to England but later was returned and held prisoner in America. Finally released, he returned to Vermont, and was made lieutenant colonel of militia.

Vermont was not a member of the Confederation, as the new nation called itself, but it wished to be admitted as a state. Allen was sent to Philadelphia in its behalf, but, while the Congress hesitated, the British tried to have Vermont swear allegiance to their king. Allen's correspondence with them was discovered, and he was accused of treason — a charge that was never proved. See GREEN MOUNTAIN Boys.

ALLIGATOR. The largest reptile of the United States is the alligator of Florida and the Gulf region. These ungainly creatures of swamp and river bank have four short legs, a thick skin, and a long tail. They resemble crocodiles closely, although they have shorter, flatter heads, feet not so fully webbed, and heavier, less agile bodies.

Alligators dwell in waters of the tropical regions of both Americas, where they may be seen, during the day, taking the customary sunbath. The Chinese alligator, found in the lower Yangtze River, is only about six feet long. In the United States alligators are seldom seen north of Florida, except in captivity, but they were once common in several states. At present there are several alligator "farms" in Florida. Millions of the reptiles have been killed for sport, and for their hides, at various times in demand for the manufacture of handsome purses, traveling bags, and shoes. Their flesh is sometimes eaten.

Females lay 200 or more eggs at a time in heaped vegetable matter, and the sun's heat hatches them. Alligators grow very slowly, and are not usually more than two feet long at the age of fifteen. It takes nearly 100 years for them to reach their full length of about sixteen feet. They are very active animals, and will devour

whatever game comes their way. After they have captured an animal, they take it into the water, drown it, and let it partially decompose. Then they tear it apart beneath the surface and swallow the chunks whole, for their teeth, although large and prominent, cannot be used for grinding. Although they defend themselves vigorously if attacked, they are timid, in spite of their size.

The alligators of South America are often called *caymans*, one species being known as the *spectacled cayman*, because of the high bony rim surrounding the orbit of each eye. See CROCODILE.

ALLIGATOR PEAR. See AVOCADO.

ALLOY, *al loi'*. Why is it that some pocket knives keep sharp blades, while others get dull quickly?

The reason is the difference in the kind of steel used in making the blades. Some steel is hardened by having other metals mixed with it. Such steels are called *alloys*. An alloy is a substance made by mixing two or more metals; sometimes it is a chemical compound, but more often a product of melting two or more metals together.

The first alloy known to man was bronze, which is copper hardened with tin. Long ago, copper, with tin already added by wise Nature, was mined in Cornwall (England), Bohemia, and China. Because it was harder and stronger than pure copper, it was highly prized for tools, spears, and ornaments. As early as 3000 B. C., Egyptians knew how to melt soft copper and shape it into useful things, but it was 1,400 years later before they discovered how to harden it into bronze by adding that soft white metal, tin. Another alloy which has been known for a long time is brass. This is copper and zinc, sometimes with a little tin added. Brass is brighter than bronze and often harder.

Try to imagine a world today without alloys. There would be no machinery, no automobiles, no railroads, no factories. Since men now living were born, scientists have learned how to make thousands

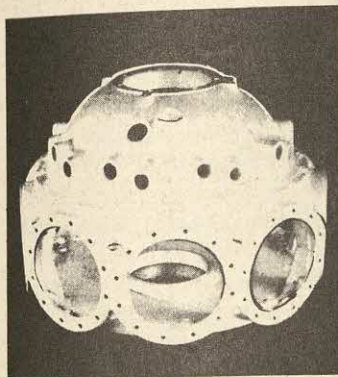
of useful alloys out of the twenty-eight common metals found in the earth. In fact, there are so many that it takes a thick book of fine print just to name and describe them.

Among the most important alloys are the alloys of steel. A bewildering number of them are made, each valuable because of some special quality. For example, add to steel a small amount of the expensive scarce metals, chromium and nickel. You will have stainless steel, used to make knives and forks, shiny tops for kitchen tables, and the great kettles and conveyors used in candy and food factories. Mixing steel with another metal called manganese makes it extremely hard and tough. The corners of the steel rails at railroad track crossings, where train wheels go bump, bump, bump, are made of this alloy, so they will not mash out of shape.

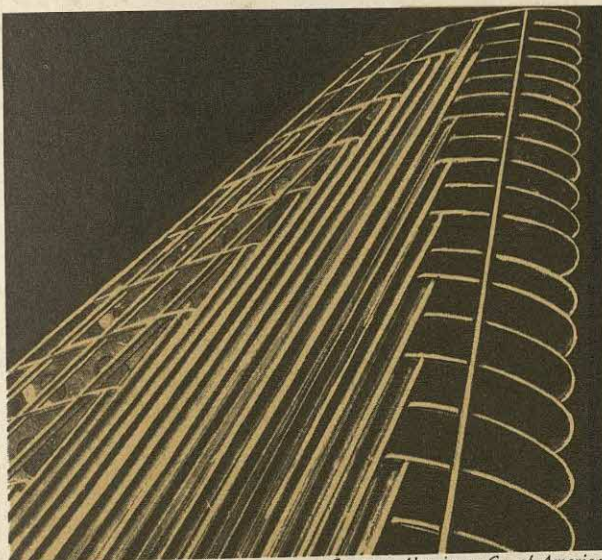
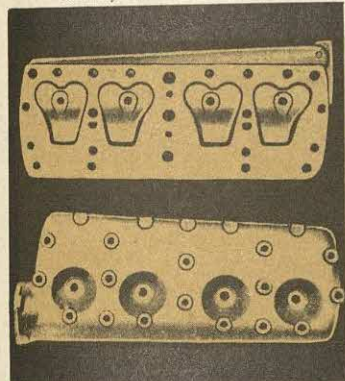
An alloy is usually designed to meet a special requirement; for instance, hardness is a property sought after for metals that must stand wear. Copper is made harder by the addition of tin or aluminum. Lead is hardened with zinc or tin. Zinc is made harder by adding a little iron. Gold is hardened with silver or copper. If jewelry were to be made of pure gold, known as twenty-four karat, it would be so soft that it would lose its shape and wear away quickly.

Hardness is not the only quality sought in an alloy. Sometimes an alloy is wanted that is very strong, for uses such as piano wire. At other times an alloy is desired that is bright, rust-resisting, or springy; hard to melt or easy to melt. The steel in the walls of a high-pressure boiler must not melt, even when heat turns it cherry-red, but the solder that a plumber uses must melt and flow easily.

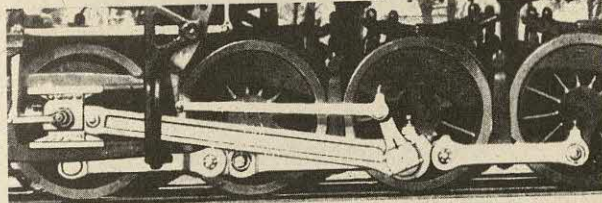
Often, the need for lightness governs the choice of an alloy, such as duralumin, an alloy of aluminum with copper, manganese, and magnesium. Light but strong and tough, duralumin, one of the most important of the aluminum alloys, is used in making ships, planes, trains, and cars.



Courtesy Aluminum Co. of America



Courtesy Aluminum Co. of America



MARVEL ALLOYS made of common metals increase the speed of aircraft, streamline trains, and racing cars by decreasing weight and danger of metal "fatigue." Tough alloy parts like the motor's radial crankcase, the airplane's cantilever wing, the engine's cylinder head, and the locomotive's drive shaft stand up under the hardest service.

You probably know and use a lot of alloys. Gun metal is an alloy of copper and a little tin. Monel metal is two-thirds nickel and nearly one-third copper, with small amounts of other metals. Pewter, the dull, leadlike metal used to make pitchers, plates, and cups, is mostly tin, with antimony, lead, and copper added. Plumbers' solder is just lead and tin.

Type metal is an example of an alloy developed to meet a definite need. Type metal should have a low melting point and should expand as it hardens in order to make a clean, sharp casting. An alloy made largely of lead, which expands when heated, with smaller amounts of antimony and tin has the qualities needed for satisfactory printer's type.

The experimental mixing of metals which resulted in the bronze hatchet, the Damascus blade, the Sheffield platter, the

duralumin airplane frame, is now succeeded by intensive research. Keen intelligence and industrial chemistry are constantly producing more alloys that affect every phase of modern life. (See the articles on the various metals.)

ALL SAINTS' DAY. A festival in the Roman Catholic and Anglican churches, All Saints' Day is celebrated on November 1. It is set aside for honoring all the saints, especially those not having a fixed festival during the year. It was instituted about 610. See HALLOWE'EN.

ALL SOULS' DAY. Celebrated on November 2 by Roman Catholics, in February by the Greek Orthodox Church, this holy day is set aside for offering prayers and masses for the souls of all the faithful in purgatory. In some countries food and flowers are placed on graves, and candles are burned there.

ALL'SPICE. Because it seems to combine the flavors of cinnamon, nutmegs, and cloves, the dried green berry of the pimento tree has come to be known as allspice. The tree is a beautiful West Indian species of myrtle, with fragrant white flowers and shiny leaves of deep green. The fruit is also called Jamaica pepper, as the market supply is chiefly from the plantations of that island. Allspice is used in cooking to season foods and to spice cordials or pickles. In medicine it masks disagreeable drugs, giving them a spicy odor and taste. It also forms the basis of a distilled aromatic water and an essential oil used in toilet soap.

ALU'VIUM. The deltas and flood plains built up by many large rivers, such as the Mississippi and the Nile, consist of fertile soil called alluvium. This word comes to us from the French for *to wash*; alluvium is, in fact, material washed down by that valuable earth-changing agent, water. Water works to form alluvium by collecting enormous amounts of top soil from higher grounds, which it deposits on the plains, in the valleys, and at the mouths of rivers. Alluvium consists of loam, sand, clay, and gravel, and can be found along the banks of most streams of considerable size. See DELTA; EROSION; FLOOD PLAIN; RIVERS.

ALMA MATER, *al'muh ma'tur* or *ahl'-muh mah'tur*. This term, commonly used by students and graduates to refer to their university or college, is made up of Latin words meaning *fostering mother*. First used by the Romans for their earth goddesses, it came to be applied to universities and colleges during the Middle Ages.

ALMANAC, *awl'ma nak*. Although the ancient Romans are known to have had almanacs, the oldest existing ones are in the form of manuscripts dating back to the 1300's and 1400's. At first, these were devoted to predictions of events for the coming year, based on interpretations of the movements of the heavenly bodies. Although their astronomical predictions were largely guesswork, they were very popular,

and after the invention of printing, almanacs were among the most commonly published works. One of the most important of these was the *Ephemerides ab Anno, 1475-1506*. Published by Johann Müller, a German astronomer and mathematician known as Regiomontanus, it was used by Columbus and other seamen.

In time, however, the effect of the wrong guesses of these almanacs regarding the future were so frequently harmful that some governments banned their publication. Moreover, so many readers discovered their inaccuracies that the nature of almanacs was gradually changed, and many of them came to be compendiums of facts. One of the first of this type was the *British Almanac*, first issued in 1828 by the Society for the Diffusion of Useful Knowledge. Although many unreliable almanacs containing astrological predictions are still published, usually as advertisements, many others contain accurate information.

Well-known modern "yearbooks" of this type include *The World Almanac and Book of Facts*, *Information Please Almanac*, and *The Statesman's Year-Book*. Still other reliable almanacs deal with special subjects. One of the most famous is the *Almanach de Gotha*, first published in the German city of Gotha in 1763 and noted for its information regarding the family trees of the royalty and nobility of all countries. Another famous work dealing with a special subject is the *American Ephemeris and Nautical Almanac*, issued by the United States Navy and containing information about the sun, moon, planets, stars, tides, eclipses, weather, latitude, longitude, and many other matters of value to navigators and astronomers.

The most famous of American almanacs was *Poor Richard's Almanack*, started by Benjamin Franklin in 1732 and issued until 1757. Translated into many languages, it contained among other things many of Franklin's still-quoted proverbs and witticisms. Also popular is *The Old Farmer's Almanack*, which has been published in the United States since 1792.



BOTH SWEETS AND POISON COME FROM ALMOND TREES

But each variety has flowers like these (left) and thick-skinned fruit (right). The nuts we eat are the seeds contained in the fruit of the "sweet" almond, which has pink flowers. The seed of the "bitter" almond, which bears white blossoms, contains deadly poisonous prussic acid.

ALMOND, *ah'mund*, or *al'mund*. Two varieties of nuts are borne by the almond tree. One is the sweet almond, a delicious food and the source of an oil used in flavoring. The other variety, the bitter almond, contains the highly poisonous prussic acid. The almond tree, which is native to Africa, Asia, and Southern Europe, is cultivated in England for its beauty and in the southwestern part of the United States for its nuts. California produces most of the commercial crop.

The tree usually grows to a height of twenty feet and belongs to the same family as the peach and the nectarine trees. The blossoms of the sweet almond are pink, and those of the bitter almond are white. Almond leaves are oval, pointed, and delicately notched. The fruit has a soft, feather-like outer coat which covers the flattish wrinkled stone containing the seed, or kernel.

ALPACA. Although the sheep has always been our chief wool-bearing animal, a long, soft, and silky wool, even straighter and stronger than that of the sheep, is furnished by the alpaca. Its wool is woven into fabrics of great beauty, known as alpaca and used for shawls, clothing for warm climates, coat linings, and umbrellas.

The alpaca is a cud-chewing animal of the camel tribe and is native to the Andes Mountains of South America, being found chiefly in Chile and Peru. It is so closely allied to the llama, another South American wool-bearing animal, that sometimes it is considered a smaller variety of the llama rather than a distinct species. The alpaca is both a wild and a domesticated animal. In form and size, it is like the sheep, but it has a longer neck. The flesh of the alpaca is agreeable to eat and is wholesome. See LLAMA.

ALPHABET, *al'fa bet*. Before he learns to write the letters of the alphabet, a child will usually draw pictures of objects about him, and before he learns to read the names of objects, he will identify them by pictures. So it was in the childhood of mankind. Our early forefathers, who lived in caves, had no written language, but they tried to record their hunts by carving or drawing likenesses of animals and hunters on their cave walls. These crude pictures, depicting stories of real happenings, were man's first attempts at writing.

As time passed on and a higher civilization arose in the valley of the Nile, a similar but more complicated form of picture writing was developed by the Egyptians.

Their writings, found on old papyrus and stone tablets, show that the Egyptians used many odd-looking marks to spell out a word, and then, to give the word the correct meaning, they added a picture, or series of pictures, after it. Some of these characters represented syllables, while others were real letters, which could be used in

The Greeks derived their alphabet from the Phoenicians, as did the Hebrews; thus the Greek and Hebrew alphabets were very similar. An example of what the Phoenicians did to modify the Egyptian alphabet is shown in the letter *b*. When the Egyptians wished to describe a house, they drew a picture of one. The Phoenicians

Hebrew Names of Letters	Meaning in English	English Equivalent	Egyptian	Phœnician	Old Hebrew	Square Hebrew	Old and Later Greek	Old and Later Latin
Aleph	Ox	A						
Beth	House	B						
Gimel	Camel	G						
Daleth	Door	D						
He	Window	H, E						
Vau	Hook	V						
Zayin	Weapon	Z						
Cheth	Fence	Ch						
Teth	Snake	Th						
Yod	Hand	Y, I, J						
Kaph	Bent Hand	C, Ch						
Lamed	Ox-goad	L						
Mem	Water	M						
Nun	Fish	N						
Samekh	Post	S						
Ayin	Eye	O						
Pe	Mouth	P, Ph						
Tsade	Javelin?	Ts						
Koph	Knot?	K, Q						
Resh	Head	R						
Shin	Tooth	Sh						
Tau	Sign (Cross)	T, Th						

LIFE STORY OF OUR A, B, C'S.

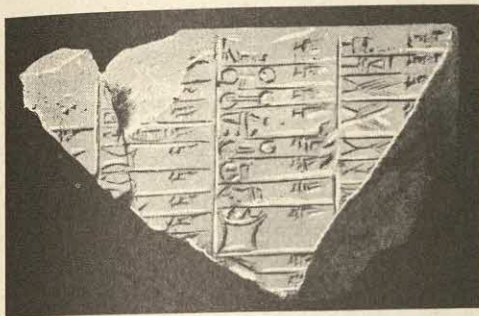
an alphabet such as we use today.

The people of Babylon and Assyria simplified this form of writing to some extent, and used wedge-shaped marks to describe the sounds made by the voice. These marks, however, indicated groups of syllables, rather than letters representing each sound, and so did not form a real alphabet.

The Phoenicians took the Egyptian writings as a basis, and reduced all the sounds made by the voice to twenty-two characters. These, however, were all consonants.

gave this picture a name, *beth*, and this word came to mean *b*. The Hebrews took the same word, and, in that language, *beth* still means *b*.

The Greeks, when they adopted the Phœnician alphabet, took *b*, but instead of *beth*, they changed it slightly to *beta*. Since *a*, or *alpha*, was the first letter, and *b*, or *beta*, was the second, the whole series of characters representing the sounds of the language became known as the *alphabet* (alpha-beta), and it has come to be the



CUNEIFORM—ONE OF OUR ALPHABETICAL ANCESTORS

name for the characters of any language, either written or spoken.

The Romans derived their alphabet from the Greeks, and it is from the Latin language that English and other European languages have sprung. Thus, the history of the alphabet can be traced back through the Romans, Greeks, Phoenicians, and Egyptians to the beginning of history.

Our English alphabet is far from perfect. It has only five characters for vowels, and each of these vowels has several sounds. Then, again, some characters are not needed. For example, the letter *a* has eight different sounds, but there is only one character. On the other hand, the letter *c* has only two sounds, represented by *k* and *s*, and there are separate characters in the alphabet for both of these sounds. Sanskrit, the language that was used by the ancient Hindus, has a more nearly perfect alphabet, using fourteen characters for the vowels and diphthongs, and thirty-three for the consonants.

An interesting American-Indian alphabet was once invented by Sequoya, a Cherokee. He first tried pictures, but gave that up, and then used over 200 characters, which later were reduced to eighty-six. When the United States government became interested, it published a newspaper called *The Cherokee Phoenix*, which was printed partly in Indian.

For additional information see the articles on letters which begin each alphabetical listing in this work; see, also, ORTHOGRAPHY, and articles on the more important languages of the world.

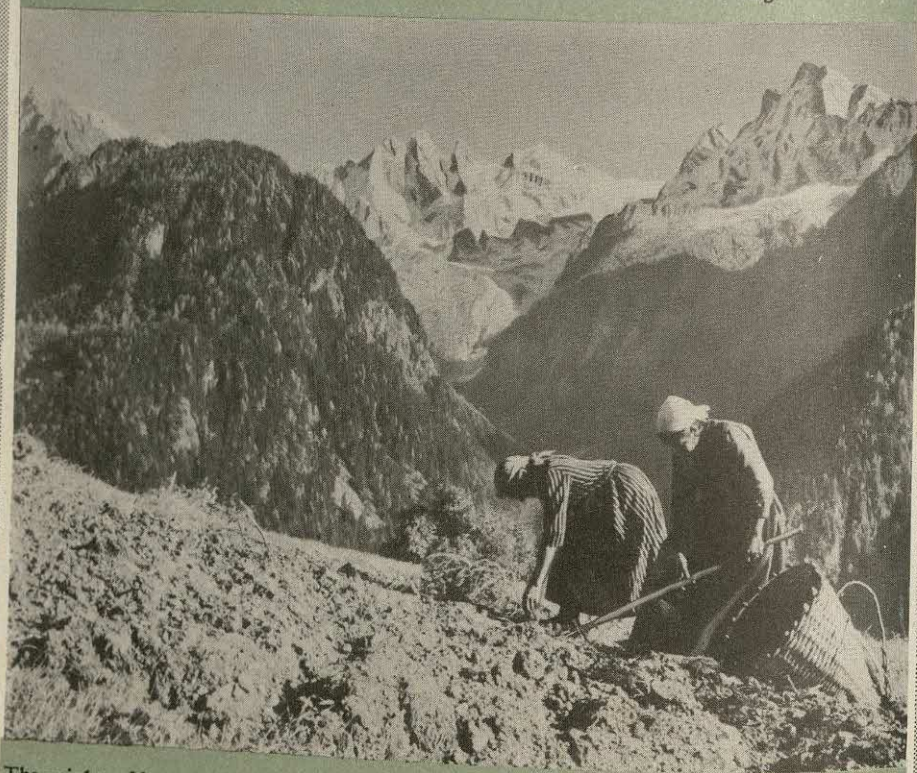
ALPS. Highest and longest of the ranges of continental Europe, the Alps form a lofty watershed between the river systems of the north and the south. Portions of this chain are located in France, Italy, Switzerland, Germany, Austria, and Yugoslavia. Over the centuries the mighty wall has played an important rôle in the fascinating story that makes up the history of the continent of Europe. The location of the Alpine chain between the Mediterranean Sea and the north European plain made it a formidable barrier in ancient times, when it separated the civilized world from the land of the barbarians.

The Alps retarded, but they could not check, the progress of Roman civilization through Europe. These mountains are not a compact mass, but form a series of high ranges and deep valleys. Through gaps in the mountains, in 218 B. C., Hannibal led his Carthaginian soldiers toward Rome in the effort to conquer that city. The legions of Julius Caesar poured through the Alpine passes when they marched to the conquest of Gaul, and in the latter days of the Roman Empire, hordes of barbarians came down from the north through the Alps, to slay and pillage. Napoleon's use of the mountain routes, and the road he built to aid him in his campaigns, belong to modern history.

The scenic beauty of this great system is known the world over. Colorful lakes, rugged snow-covered peaks, glaciers, and Alpine farms combine to make the mountains a region of infinite charm and interest. The highest of the peaks are Mont

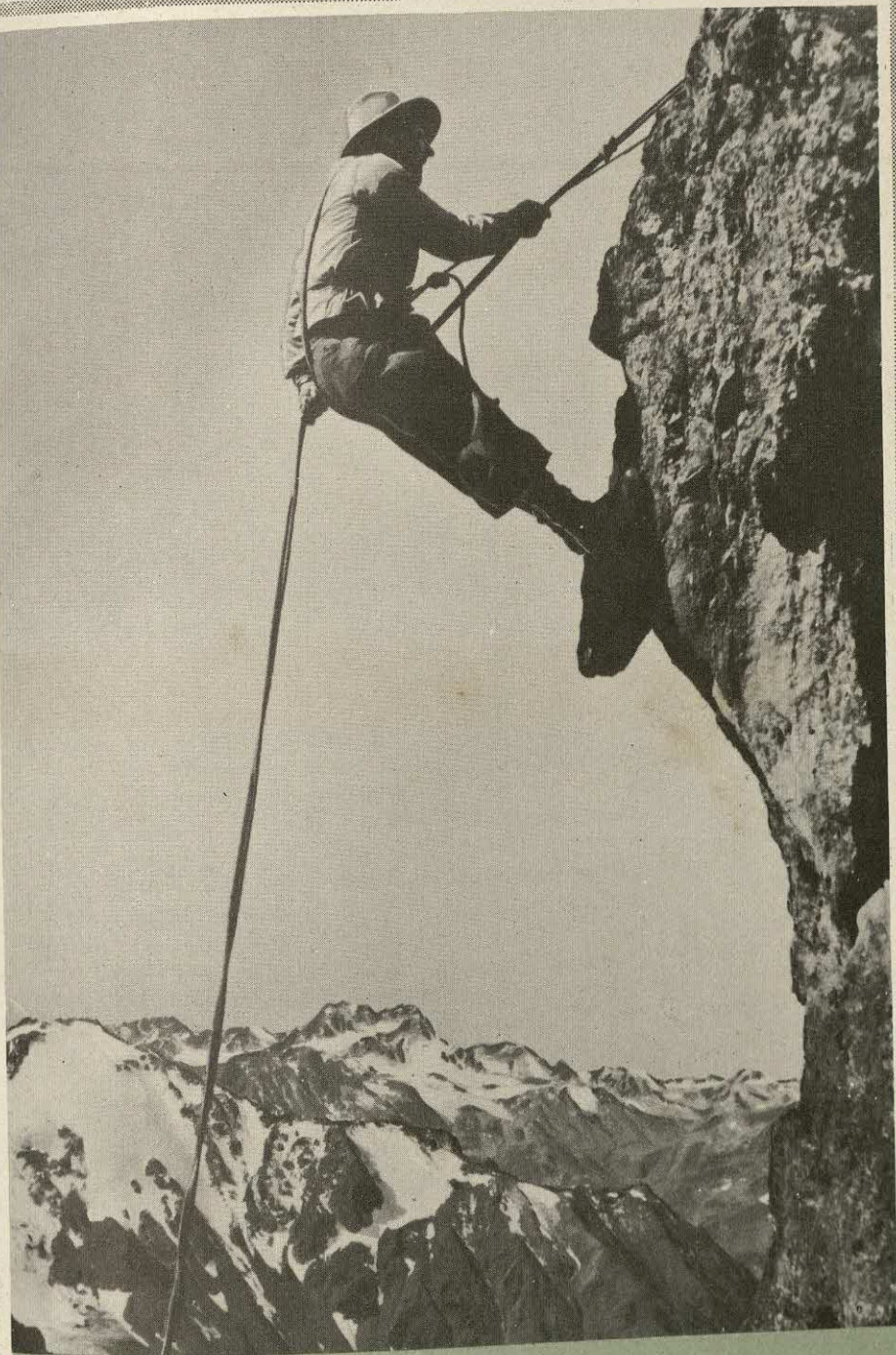


The gleaming, snow-clad slopes of the Alps are ideal for skiing.



The mighty Alps provide work as well as play, as these two peasant women laboring on a barren hillside well know.

A. Steiner



The sheer peaks of the Alps are a challenge to the skilled climber.



A PICTURESQUE VALLEY IN THE SALZBURG ALPS

Johannes Wanke

Most farms in the Alps are in the valleys and on the low slopes. High above the valleys are alpine pastures which are used for grazing livestock during the spring and summer months.

Blanc, 15,781 feet; Monte Rosa, 15,217 feet; the Matterhorn, 14,782 feet; and Jungfrau, 13,670 feet.

The range as a whole is shaped like a crescent, with spurs extending to the Apennines, the Vosges range, the Hartz chain, the Balkans, and the Carpathians. Mer de Glace, on the northern slope of Mont Blanc, and the Rhone, source of the river of that name, are among the most famous Alpine glaciers. The Swiss Alps, containing such well-known resorts as Lucerne and Interlaken, and that renowned winter playground, Saint Moritz, are probably the best loved and most appreciated of the Alpine ranges.

These mountains are crossed by railroad lines and motor roads. One of the most famous roads, leading from France to Italy, was built by Napoleon over Mont Cenis, at a height of 6,773 feet. A railroad tunnel has since been carried through this mountain, and others include the Saint Gotthard, the Simplon, and the Arlberg. Among the famous Alpine passes is the Saint Bernard, known for its inn and life-saving dogs. Inns and shelters

for mountain climbers are found in all the traveled sections of the Alps.

High up the mountains are the wild goat, or steinbock, and the graceful chamois. Edelweiss, hardy roses and violets, and trees grow to heights of 8,500 feet, and on the lower slopes are cultivated farms, pasture land, and towns.

Additional information may be found under the headings listed below:

Chamois	Mont Blanc
Interlaken	Saint Bernard,
Jungfrau	Great
Matterhorn	Saint Gotthard
Mer de Glace	Simplon

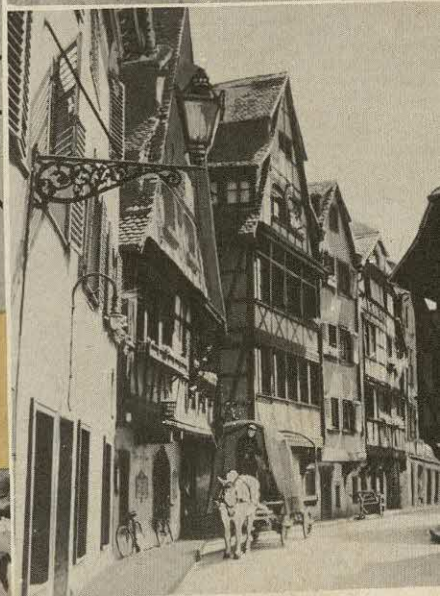
ALSACE-LORRAINE, *al sahs'-lo rane'*.

One of the key territories in Europe because of its rich iron and coal deposits, Alsace-Lorraine has been the subject of border disputes between France and Germany for many years. It now belongs to France. It is a strip of land dividing the two countries, with Switzerland at its southern tip and Belgium at its northern. The length of the territory from north to south is about 125 miles; its width varies from 22 to 100 miles, and its area is 5,605

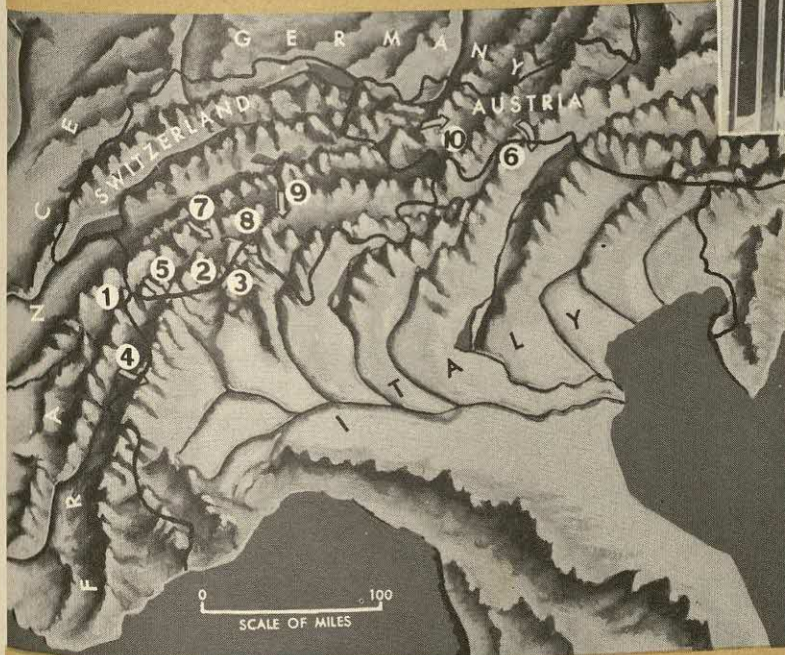


ALSACE-LORRAINE: HISTORIC HOT-SPOT

Located close to the border between France and Germany, Alsace and Lorraine have had a troubled history. Yet the ancient towns (right) and rolling fields (right above) retain an atmosphere of calm and tranquillity.



By Ewing Galloway, N.Y.
French Embassy Press & Information Division



MOUNTAINS

- 1 MONT BLANC
- 2 MATTERHORN
- 3 MONTE ROSA

PASSES

- 4 MT. CENIS PASS
- 5 GREAT ST. BERNARD PASS
- 6 BRENNER PASS

TUNNELS

- 7 LÖTSCHBERG TUNNEL
- 8 SIMPLON TUNNEL
- 9 ST. GOTTHARD TUNNEL
- 10 ARLBERG TUNNEL

ALPINE PEAKS CAP THE ITALIAN BOOT

The Alps form a great natural barrier on the European continent, but travelers, traders, and invaders have moved through the mountains since ancient times. In the past, they followed passes between the

square miles, or a little more than that of the state of Connecticut.

The eastern part of the territory is a plain sloping toward the Rhine River, which forms the eastern border of Alsace, separating it from Germany. The plain contains occasional marshes and swamps. The Vosges Mountains, rising in places to a height of 4,700 feet, cross the western part of the land. Because of the valuable iron and coal deposits in these mountains, Alsace-Lorraine has become a leading iron-producing territory of Europe. Quantities of fruit are grown in the mountain regions, and vine culture is of long standing importance.

Alsace-Lorraine is also important for its manufacturing interests. The leading manufactures are cotton, woolen, and silk goods, and iron products, including pig iron, machinery, and tools. While fabrics are made in large factories in the cities, cloth is still woven in country homes on hand looms. The important towns are Strasbourg, the capital and metropolis (over 190,000); Metz, Mülhausen, and Kolmar.

Alsace-Lorraine was under the control of the German tribes in the fourth and fifth centuries. The Franks lost it to the Germans in the tenth century. In the sixteenth century it again came under French control. The Peace of Westphalia, in 1648, gave the Hapsburg territory in Alsace to France. Louis XIV of France seized the free cities, Strasbourg and Kolmar, and his control over them was established by the Treaty of Ryswick in 1697.

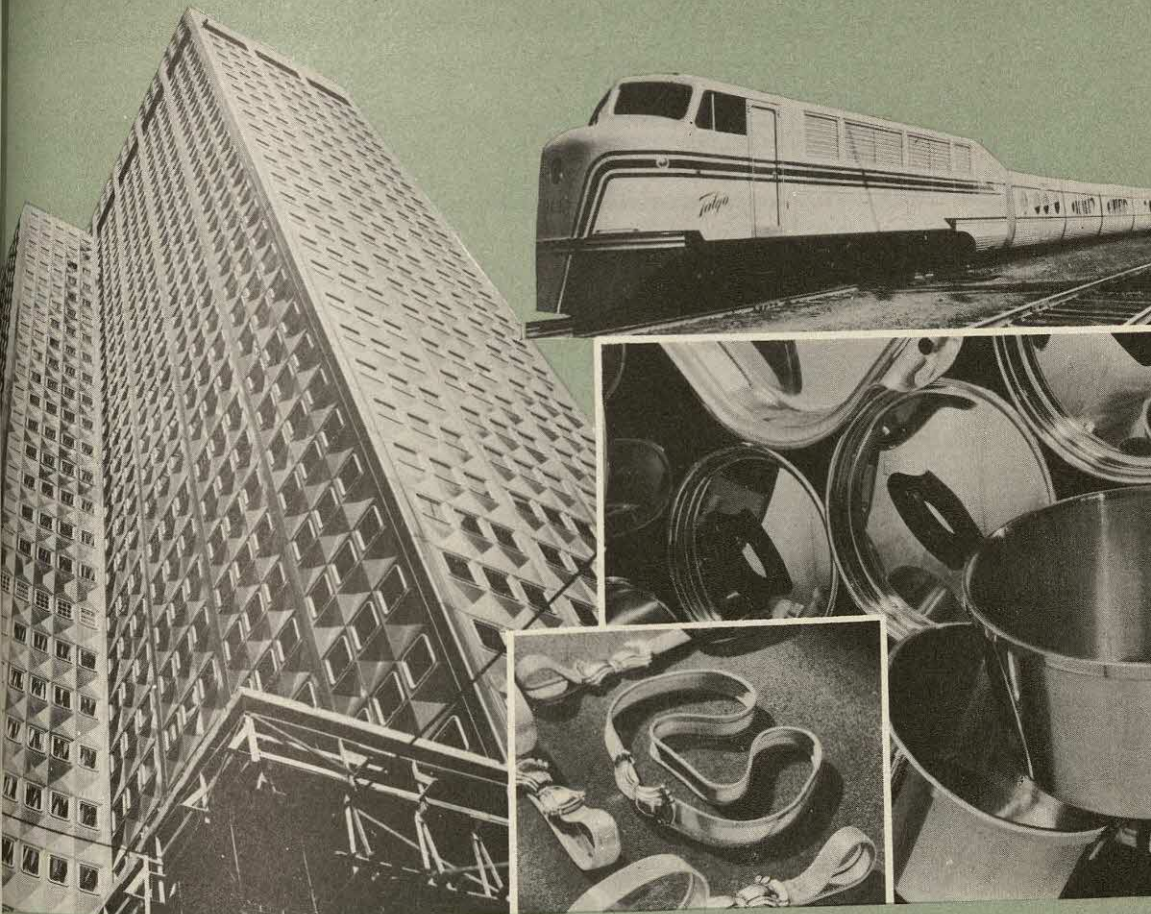
At the close of the Franco-German War, in 1871, France had to cede Alsace and about one third of Lorraine to Germany, although many inhabitants of the territory were opposed. In 1872, Emperor William I of Germany compelled the inhabitants of these areas to declare themselves for either French or German citizenship; and of the 150,000 who declared for France, about one third moved into French territory. In both the first and the second World War, Alsace-Lorraine was a battleground for

Allied and German armies. The territory, which had been ceded again to France after World War I, makes up the French *departements* of Bas-Rhin, Haut-Rhin, and Moselle. See FRANCE; GERMANY; WORLD WAR I; WORLD WAR II.

ALU'MINUM. In a college classroom at Oberlin, Ohio, one day in 1883, a youth of nineteen was listening to a chemistry lecture. The professor was describing aluminum, a metal discovered in 1827, but then so rarely produced in pure form that it was treasured like gold and platinum. The attentive listener heard the teacher say that any man who could discover a cheap way to produce aluminum would make himself a fortune and do the world a great service. The student, Charles Martin Hall, nudged a classmate and whispered, "I'm going after that metal!" Go after it he did, although he knew that great scientists had not yet reached the goal of commercial production.

Three years later, just a few months after his graduation, the young man burst excitedly into a college hall and cried, "Professor, I've got it!" He had learned that aluminum, present with other substances in much of the earth's crust, but never found in its pure form, could be separated from refined ore by an electrolytic process at comparatively small cost. So Charles Martin Hall gave the world cheap aluminum, which is both light and strong; the metal that sails the skies; the silver-hued metal that forms the light but sturdy backbone of dirigible balloons and airplanes. Just a few weeks after Hall's success, a Frenchman, Heroult, also arrived at the electrolytic reduction process for obtaining aluminum, sometimes referred to now as the Hall-Heroult process.

From Clay to Metal. Aluminum is usually made from bauxite, a mineral found in certain clay beds. This ore is first refined to obtain *alumina*, a white, powdery compound of aluminum and oxygen. The alumina is dissolved in molten cryolite, in a pot lined with carbon, and then has an electric current sent through it.



Aluminum Company of Am

ALUMINUM—MULTI-PURPOSE MODERN METAL

They all use aluminum. Among the great variety of products made wholly or partly of aluminum are the streamlined train (top right), the skyscraper (left), the pots and pans (bottom right), and the ornamental belts (inset).

The current causes pure aluminum to collect in the bottom of the pot.

Airplane; Pots and Pans. Because aluminum conducts heat well, it got its start in the kitchen. Bright as silver, easy to heat, it is a favorite metal for coffeepots and other cooking utensils. Aluminum is used in the wings of the great airplanes that span continents and oceans. Aluminum gives lightness and strength to modern streamlined trains. Certain parts of automobile engines are made of aluminum, for it endures hard wear and does not rust like iron. Camera films come wrapped in thin aluminum foil.

It is a good conductor of electricity; and as it is much lighter than copper, it is used for wires to carry power. Powdered

aluminum is made into paint to protect the outside of buildings and for a first coat on raw wood. You can hardly pass a day without meeting aluminum; you find it in toys and telephones, skyscrapers, golf clubs, and washing machines, furniture, steamships, and fountain pens.

Platinum and Aluminum. Platinum and aluminum look somewhat alike. Once they were both precious metals but today platinum is the metal of fine jewelry, and aluminum is the metal of commerce. In 1879, in Paris, a man buying opera glasses was offered platinum or aluminum at the same price; he chose aluminum. In 1884 the Washington Monument was capped with a 100-ounce casting of aluminum. Years earlier, Napoleon boasted about the

aluminum buttons on his uniform, and served his favorites with aluminum forks and spoons, while less honored guests used gold and silver ware. In 1845 aluminum cost \$545 a pound; today, thanks to that American student and those that followed him, the cost is but a few cents.

Strong Aluminum Alloys. A modern achievement is the development of strong aluminum alloys, containing about 95 per cent aluminum and 5 per cent other metals which add strength without great increase of weight. These alloys, which are made into structural members for the newer types of railroad cars, automobiles, and airplanes, can be readily worked and welded; then, after heat treatment, they become as strong as similar members made of steel, but have the advantage of being much lighter.

Achievements of the "Aluminum Age." A great mass of material and quantities of electrical power are needed to produce even one pound of virgin aluminum. The cost of the essential power makes it more practical to locate production centers near available water power. This high cost of manufacture means a tremendous investment of capital in plants, labor, power, and materials, and so places this industry in the top bracket of heavily capitalized activities.

Consequently, it is a major industrial accomplishment to put on the market the present wide variety of aluminum articles, at reasonable prices.

AMAZON. The deep, wide Amazon River is the only practical east-west highway through a large part of South America. Indians travel up and down it in their long dug-out canoes, for the tropical forests along the river are so thick that it is almost impossible to build roads.

The river swarms with alligators, turtles, and a great variety of fish. Along the banks and in the forests there are many birds with bright, colorful feathers and harsh voices. Small gray monkeys chatter loudly in the treetops. Deeper in the forests, insects and mosquitoes are so nu-

merous that life is almost unbearable.

With its hundreds of tributaries, many of them over 1,000 miles long, the Amazon is the largest river system in the world. The river is formed by the union of two great branches, the Marañon and the Ucayali. The Marañon River rises in the Andes Mountains near Lima, Peru, only sixty miles from the Pacific Ocean. It joins the Ucayali just above Iquitos, in Peru.

From Iquitos to the Atlantic Ocean, a distance of over 2,000 miles, the river has an average depth of 120 to 150 feet during the rainy season. Ocean steamers are able to go as far as Iquitos, and smaller ships can go much farther up the river. Manaus, about 1,000 miles from the sea, is an important ocean port, even at low water. The total length of the Amazon is over 3,000 miles; including its tributaries, it affords about 15,000 miles of navigable waterways. The Amazon flows due east from Napo, in Ecuador, so that it is almost entirely in the same latitude. This is not the case with any other large river.

About the time of full moon, a great tidal wave rushes into the 150-mile-wide mouth of the river with such force that it raises the water almost thirty feet, and reverses the current for about 400 miles upstream. This regular occurrence, generally known as the *bore*, is called *pororoca* by the Indians. The Indians know when to expect this wall of water from the Atlantic, and when the June floods will come from upstream. They move their settlements to higher ground, but, when the waters go back and the hunting or food supply is better in the lowlands, they return to the river's banks.

The Amazon was discovered by Yañez Pinzon in 1500, but it was not explored by any European till 1541, when Orellana descended it from the Andes to the mouth. See BRAZIL.

AMAZONS. According to ancient Greek legends, the Amazons were a race of powerful women who allowed no men to live among them, except as slaves, and



WARRIOR LADY—AN AMAZON

devoted themselves to fighting and hunting. They were said to have built a great city in Asia Minor called Ephesus, on the river Thermodon, where they worshiped their gods, Ares and Artemis. The Greeks often portrayed the Amazons in their sculpture, usually showing them on horseback.

When Hercules was sent to perform his famous twelve labors, the ninth was to secure a girdle worn by the queen of the Amazons, Hippolyta. The Greek hero slew Hippolyta, after defeating her followers. The Amazons were on the side of the Trojans during the wars with the Greeks, and another Greek hero, Achilles, killed their queen, Penthesileia. These warlike women were finally vanquished in battle and wiped out when they attempted to capture Athens, during the reign of the legendary king Theseus. See **HERCULES**.

AMBAS'SADOR. Different countries discuss important matters with each other by means of diplomats known as ambassadors, ministers, and consuls. Ambassadors are the highest officials in diplomatic rank in the foreign service, and they reside in or near the capitals of the countries to which they are appointed.

Ambassadors from the United States are appointed by the President with the approval of the Senate. An ambassador receives a salary and is provided with a residence in the foreign country. Until 1893 the

United States was represented in foreign countries by ministers plenipotentiary. Then Congress authorized the President to exchange ambassadors with countries whose representatives in Washington, D. C., were of that rank. Now, ambassadors are sent to almost all countries, and ministers to a few. Both handle political relations. Consuls are assigned within foreign countries to handle diplomatic matters relating to trade.

In Canada, the Secretary of External Affairs recommends the ambassadors and the Cabinet approves the appointments. Canada began sending ambassadors to other countries in the 1920's, after the Dominion had attained a substantial degree of self-government. Now both Canada and the United States are represented in almost all countries of the world.

See **DIPLOMACY**.

AMBER, *am'bur*. On many seashores, and in alluvial soils, there are frequently dug up lumps of a yellowish, semi-transparent substance which looks somewhat like colored glass, but is neither as heavy nor as shiny as glass. This substance is called amber, and is much prized for the making of beads, cigarette holders, pipe-stems, and other small objects. When burned it gives off a strong odor and considerable smoke, and leaves an ash which is used as a coloring material.

Amber is a fossil resin, secreted by the pine trees of long ago, and buried under the earth or the water for centuries and centuries, until it was hardened and transformed into the beautiful, jewel-like substance it is today. Frequently there are found in the lumps of amber the bodies of insects, which were caught and held when the resin was new and sticky, but these are all insects of a bygone age, not found among those living today.

If amber is rubbed briskly it becomes electrical, and draws to itself certain light objects put within its radius. For this reason it had the honor of bestowing its name on the most wonderful force in the world—electricity. The Greeks called amber *elektron*, and experimented with its mag-

netic qualities; and centuries later, when the little-understood power began to be studied and needed a name, that name was fashioned from the Greek word.

Most of our amber comes from the shores of the North and Baltic seas. It is also found in some parts of North America, notably in Manitoba.

AMBERGRIS, *am' bur grees*. A fatty substance used as a base for perfumes, ambergris comes from the intestines of sperm whales which are diseased. Expelled ambergris is found chiefly in water or sand along the Atlantic shores of Africa, Brazil, and the Bahamas, but also occurs on the East Indian, Chinese, and Japanese coasts. When taken from the intestines of dead whales, ambergris has a disagreeable odor, but after it has been exposed to air, it acquires a pleasing fragrance. Lumps of all sizes up to a hundred pounds or more are found in whales. The name is from the French for *gray amber*. Ambergris may be gray, yellow, or black, and sometimes resembles shaded marble. In the manufacture of perfumes, it is usually treated with alcohol.

AMEND'MENT. Often, in Congress, in state legislatures and city councils, and in clubs and societies, it becomes necessary to change a law or resolution. Such a change is called an amendment, and it takes the place of the original order. When a bill in Congress is amended it is sent back to the house originating it. If no agreement is reached, a joint committee considers the amendments voted by either or both houses.

Amendments to the Constitution of the United States are governed by a clause of that document. Amendments may be proposed by Congress whenever two-thirds of both the Senate and the House of Representatives agree, or they may be proposed in a convention called by Congress on application of two-thirds of the state legislatures. In either case, the amendments must be ratified by three-fourths of the state legislatures before becoming part of the Constitution.

AMERICAN INDIANS. See INDIANS, AMERICAN.

AMERICAN LEGION. A few months after World War I ended, in November, 1918, groups of men met in Paris, Washington, and St. Louis, Mo., to form the American Legion. All soldiers and sailors who served in the war were eligible for membership. The Legion soon grew to be one of the largest organizations of its kind in the country. It now has a membership of well over 3,000,000. It is divided into departments for the various states and a number of foreign countries. Each department is made up of numerous posts.

In addition to many other aims, the Legion is concerned with the welfare of all disabled veterans of the World Wars and their dependents. As set forth in its constitution, the object of the Legion is to uphold and defend the Constitution of the United States; to maintain the dignity of the law; to foster pure Americanism; to combat autocracy; to promote peace; to safeguard justice, and promote mutual helpfulness. It believes in a strong army and navy.

The various departments of the Legion include those of the forty-eight states, the District of Columbia, the Territories, and several foreign cities and countries. Wives of members of the American Legion may join the American Legion Auxiliary.

AMERICUS VESPUCIUS, *ves pu' she us* (1451-1512). Though known in his own age as an explorer and writer, Americus Vesputius interests us today because the American continents were named for him. Like Columbus, who was his friend, Vesputius was born in Italy. In his native city of Florence he worked for the famous Medici family, and afterwards went to Spain, where he fitted out ships engaged in trade. Vesputius made at least two voyages to Northeastern South America between 1497 and 1505, and in later years was in the service of Spain as a pilot major. A map maker who published some letters written by Americus Vesputius, thought that the continent he had visited

should be given his first name. Eventually that name was applied to all of the New World.

AMETHYST, *am'e thist*. One of the most beautiful of the gem stones is the amethyst, a purple variety of quartz. It usually occurs in crystals, and its coloring is probably due to the metal manganese. Amethyst is found in Siberia, India, Ceylon, Persia, South America, and around Thunder Bay on Lake Superior. The Greeks wore amethysts as a protection against drunkenness and so gave the mineral a name which means *without wine*. Of course, its healing powers have yet to be proved. The stone is the birthstone of those born in February.

The *oriental amethyst* is a more costly and rarer stone, a variety of corundum, an extremely hard mineral. See **PRECIOUS STONES; QUARTZ**.

AM'MON. People of the ancient world had a variety of gods. One of them they usually considered most powerful. With the Greeks this father of the gods was Zeus, among the Romans it was Jupiter, and to the Egyptians it was Ammon. Ammon was represented as a human being with a ram's head, or simply with the horns of a ram. At a famous temple to Ammon in the Oasis of Siwa in the Libyan Desert, the faithful honored Ammon and his wife, the goddess Mut.

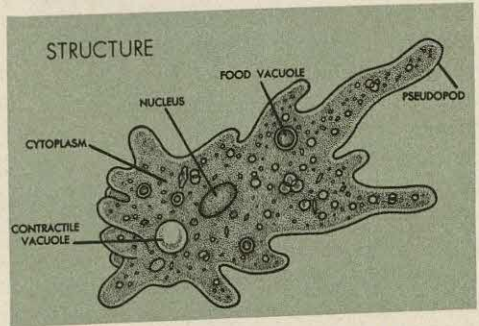
AMMO'NIA. Refrigerators, explosives, and fertilizers are some of the better known products which depend for efficiency upon ammonia. It is an alkaline substance, one that neutralizes acids and forms salts, but differs from the other alkalies in being gaseous. It is a colorless, sharp-smelling gas, composed of three parts of hydrogen to one of nitrogen.

This high nitrogen content makes ammonium compounds valuable as plant food, and agriculture, accordingly, requires great quantities of such chemicals for fertilizer. In industry, ammonia is widely used to cool storage warehouses, and ammonium salts enter into dyeing, metal working, and many chemical processes.

For household cleansing and medical use, it is supplied in solution, in water.

Ammonia was first procured in the gaseous state by Priestley, an English scientist of the eighteenth century, who called it "alkaline air." For commercial purposes, it is now obtained by various processes, in which nitrogen and hydrogen are combined. It may also be obtained as a by-product in coal gas, coke, and petroleum production. Vegetable matter and refuse animal matter are other sources.

AMMUNITION, *am mu nish'un*. The projectile, powder, and primer to ignite the powder are the ammunition for any gun. Different kinds of ammunition, such as bomb and bullet, gunpowder, explosives, shrapnel, and shell, are described in these volumes under their titles.

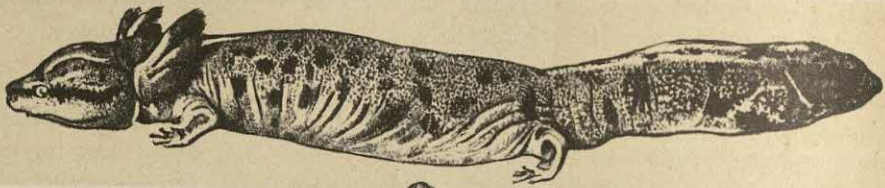


LOWEST FORM OF ANIMAL

The one-celled amoeba, simplest of all creatures.

AMOEBIA, *a me'bah*. The simplest form of animal life is the one-celled amoeba. Biology classes often select the amoeba for study because it can be easily obtained and because it is an example of a living cell, the unit of structure of all life. It is found in shallow water, either fresh or salt, where it clings to weeds, dead leaves, and other objects under the surface. Invisible to the naked eye, it rarely becomes more than 1/150 of an inch in diameter. In spite of its microscopic size and its single cell, it is able both to digest food and to reproduce itself.

The amoeba constantly changes its form by sending out little finger-like projections called *pseudopodia*. Whenever one of



these "fingers" comes in contact with anything that can be digested, the amoeba flows around it and absorbs the food as though a special stomach were used. When the digestion is complete, a large part of the waste matter is passed out of the general surface of the cell.

Amoebas increase in number by the simple process of division. A line merely forms through the living substance of the cell and a single amoeba becomes two.

The amoeba appears like a shapeless blob of jelly. The central part is about half transparent and resembles ground glass in appearance. Around the outer is a border of wholly transparent and colorless substance. Within the central part may be seen a small mass which is a little darker than the rest. This is the *nucleus*. The amoeba cell consists of a substance called *protoplasm*. See PROTOPLASM.

AMPÈRE, *ahm pare'*, ANDRÉ MARIE (1775-1836). One of our most important electrical units was named after the great French scientist and mathematician, André Marie Ampère. The ampere (*am'-peer*) is the unit of intensity of an electric current, and the device or meter that measures the number of amperes flowing in a circuit is an *ammeter*.

Ampère was born at Lyons. He early took an interest in the sciences, and at the age of twenty-six he was appointed professor of physics in the central school of



These are *amphibians*. A "mud puppy" (top) and (bottom) a frog. Both live in America.

the Department of Ain, at Bourg. He became widely known for his teachings there, but later increased his reputation in Paris, where he was a teacher of sciences. In 1824 he was made professor in experimental physics in the College of France, and it was while serving in this capacity that he made many of his important discoveries. Ampère was an authority on the nature of electric currents, and was the first to show the fundamental relationships that exist between electricity and mag-

netism. See ELECTROMAGNETISM.

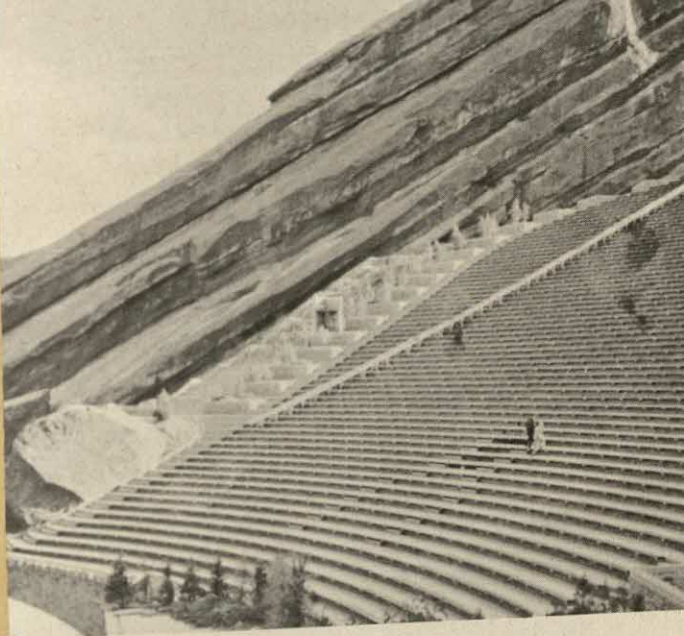
AMPHIBIANS, *am fib'e anz*. From a Greek word meaning to *have a double life* comes the name amphibian, which is applied to cold-blooded animals that live both in water and on land, and hatch from eggs.

The frog is an amphibian that begins life as a tadpole. A tadpole is very much like a fish: it has a tail and swims about in the water; and it breathes by means of gills, small organs which take oxygen from the water. After eight or ten weeks, the tadpole swims to the edge of his pond and begins to sniff air into his lungs. As he breathes, his lungs get larger and his gills gradually disappear. Other changes take place. The tadpole's tail gets shorter and shorter until it is entirely gone. His fore and hind legs grow longer and stronger. If the weather is warm, these changes are completed in about a week.

The tadpole has become a frog. He

BEAUTY IN STONE

A masterpiece of natural and man-made architecture is found in the Red Rock Amphitheater near Denver, Colo. The weathered face of a natural stone fault forms part of the frame for the smooth and uniform seating tiers where nine thousand people can enjoy the arts and nature.



spends the rest of his life in marshes near the water, where he can dive to escape his enemies. He is an expert swimmer but he cannot live in the water without coming to the surface at intervals, for air.

There are two main divisions of the amphibians: the tailless group, represented by the frogs and toads; and the tailed, such as newts and salamanders. See FROG; NEWT; SALAMANDER; TOAD.

AMPHITHEATER, *am' fe the a tur*. In the days of ancient Rome, the people of the Roman cities watched combats between the slaves, and other spectacles, in huge, roofless, oval-shaped or circular stadiums called amphitheaters. The spectators sat in tiers of seats about a great central space, or arena.

The first amphitheater in Rome was built of wood in 46 B. C., by Julius Caesar. In 30 B. C., under Augustus, Rome's first emperor, the first amphitheater partly of stone was built. In the Colosseum, or Flavian Amphitheater, in Rome, the ruins of the largest of all the ancient amphitheaters may be inspected. The Colosseum could seat 50,000 persons and it provided standing room for 30,000 more. One of the best examples remaining is at Verona, Italy. It is 502 feet long and 401 feet wide. See COLOSSEUM; STADIUM.

AM'STERDAM, NETHERLANDS. On a low site, crossed by the Amstel River, is the largest city and commercial capital of the Netherlands. Like Venice, this city is for the most part built on piles. Numerous canals divide Amsterdam into ninety islands, connected by 300 bridges.

This interesting Dutch city is one of the chief commercial ports of Europe. Its harbor, formed by an arm of the Zuider Zee, lies along the north side of the city and is surrounded by busy docks and basins. An immense water commerce uses the great ship canal, fifteen miles long and twenty-two to twenty-six feet deep, which was completed in 1876 and connects the harbor directly with the North Sea. Another canal, the North Holland, forty-six miles long and twenty feet deep, connects Amsterdam with the Helder, a fortified port on the North Sea. Industrially the city is famous as a world center of diamond cutting. See ZUIDER ZEE.

Amsterdam is also renowned as a center of art and learning. It was the home of Rembrandt, greatest of Dutch painters. Among the principal buildings in Amsterdam are the palace or royal residence, and the Bourse, the Rijks Museum, and the New Church (Saint Catherine's), founded in 1408. The population is about 872,000.

AMUNDSEN, *ah' mun sen*, ROALD (1872-1928). Although Amundsen's chief claim to fame is his discovery of the South Pole, an earlier voyage accomplished something that had been the goal of explorers for 400 years. In 1905 he sailed his ship, the *Gjoa*, through the Northwest Passage, sought by European nations since the sixteenth century, as a route to the Orient.

Amundsen was born at Borje, Norway, and was educated for the navy. As first mate of the ship *Belgica*, he engaged in Antarctic explorations in 1897-1899, but his first really notable work was done in 1903-1905, through his search for the north magnetic pole. He proved that this pole is not stationary. It was on this expedition that he sailed through the Northwest Passage.

Amundsen began his history-making voyage to the South Pole in 1910. In Nansen's ship, the *Fram*, he reached the Antarctic in January, 1911, and established a camp on the great ice cap. In October of that year, he and four companions began the long sledge journey, and, after weeks of hardships, reached the Pole on December 14. Their tent and Norwegian flag were found later by the ill-fated party of Robert Falcon Scott. Amundsen returned to make an extended lecture tour. The story of his discovery is contained in his book, *The South Pole*.

In June, 1928, Amundsen and his crew of five were lost, in the Arctic regions, in an airplane attempt to rescue members of a wrecked Italian airship expedition. See SCOTT, ROBERT FALCON.

AMUR, *ah moor'*. This river of Siberia marks the northern boundary of Manchuria. It is formed by the union of the Shilka and Argun rivers, and is about 2,700 miles long. It empties into a strait that opens into the Sea of Okhotsk. For the most part the Amur is open for summer navigation and is a valuable commercial waterway. A new port, Nikolaievsk, has been opened at the mouth of the Amur, to relieve overcrowding of the harbor of Vladivostok.

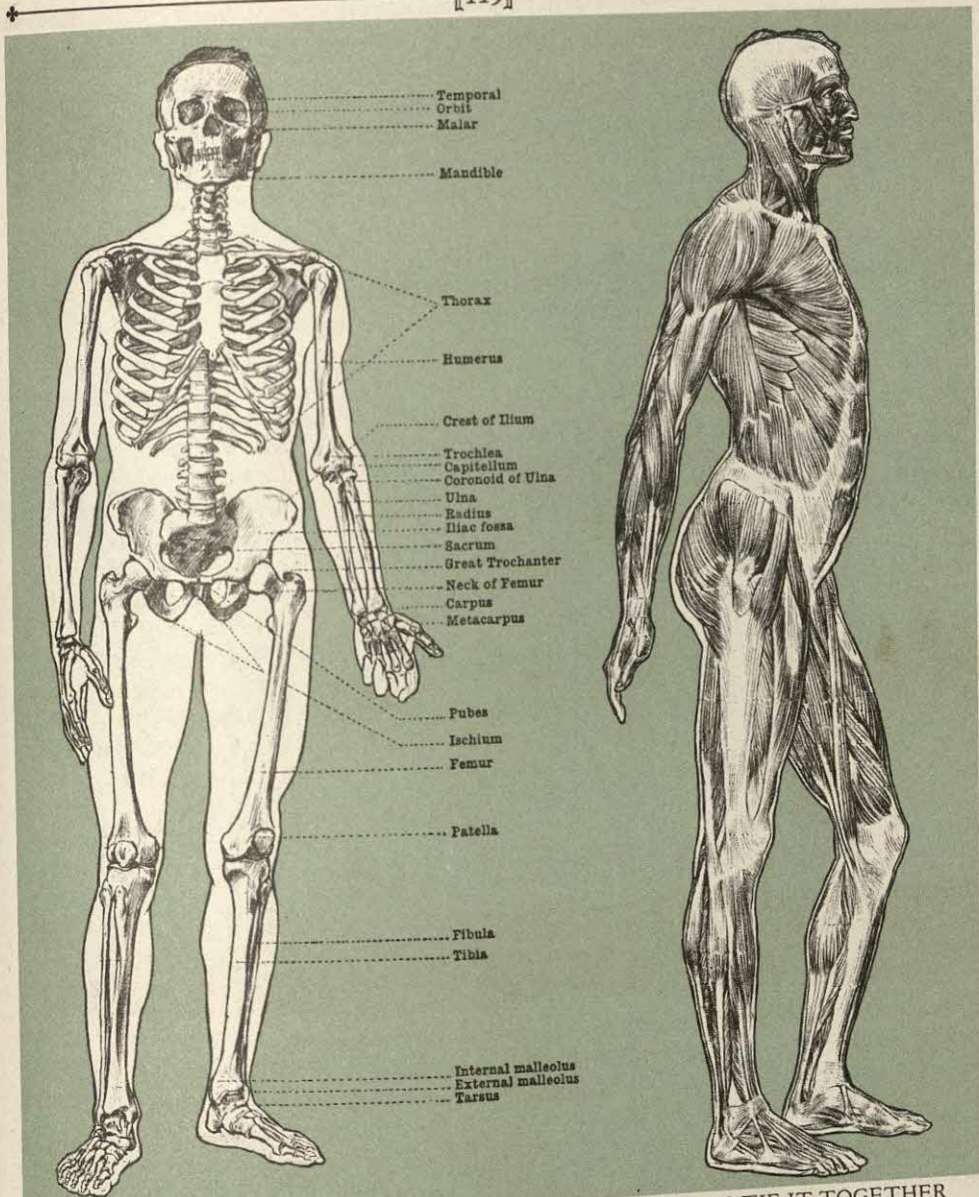
ANACON'DA. This name is often applied to any large serpent that crushes its victims before devouring them. The great boa of South America and the python of the Old World are the best known of the anacondas. See BOA; PYTHON.

ANATOMY, *a nat' o mi*. When scientists wanted to describe their study of the structure of animals and plants, they selected the Greek word *anatomy*, which means *cutting up*. Cutting up, or surgery and dissection, was necessary before students of the human body could gain any accurate knowledge of the most complicated living machines in the world.

Human anatomy is viewed from various standpoints, according to the object to be attained. The physician seeks knowledge of the size, shape, location, structure, functions, and relationship of the various structures as they appear in health; this is called *descriptive anatomy*. The surgeon studies the body to learn the best methods of correcting defects by operations; this is *surgical anatomy*. The intimate knowledge of the structures obtained by the aid of the microscope is the field of *histology*. A similar study of diseased tissues is known as *pathology*. *Comparative anatomy*, involving a study of many forms of animal life in connection with the knowledge of the human frame, affords a better understanding of man, that highest form of all forms of life.

Sculptors and painters study the body from the standpoint of *artistic anatomy*, in which special attention is given to proportions and to outlines which correspond to hidden structures. The sculptor does not attempt to reproduce the exact proportions of the body, but adopts such as produce the most pleasing effects. For such purposes, special scales of measurement are required.

The history of anatomy begins with the earliest written records of the Egyptians. From these people, knowledge of the subject passed to Greece. Hippocrates (born 460 B. C.), the "father of medical science," was the first noted anatomist of the ancient



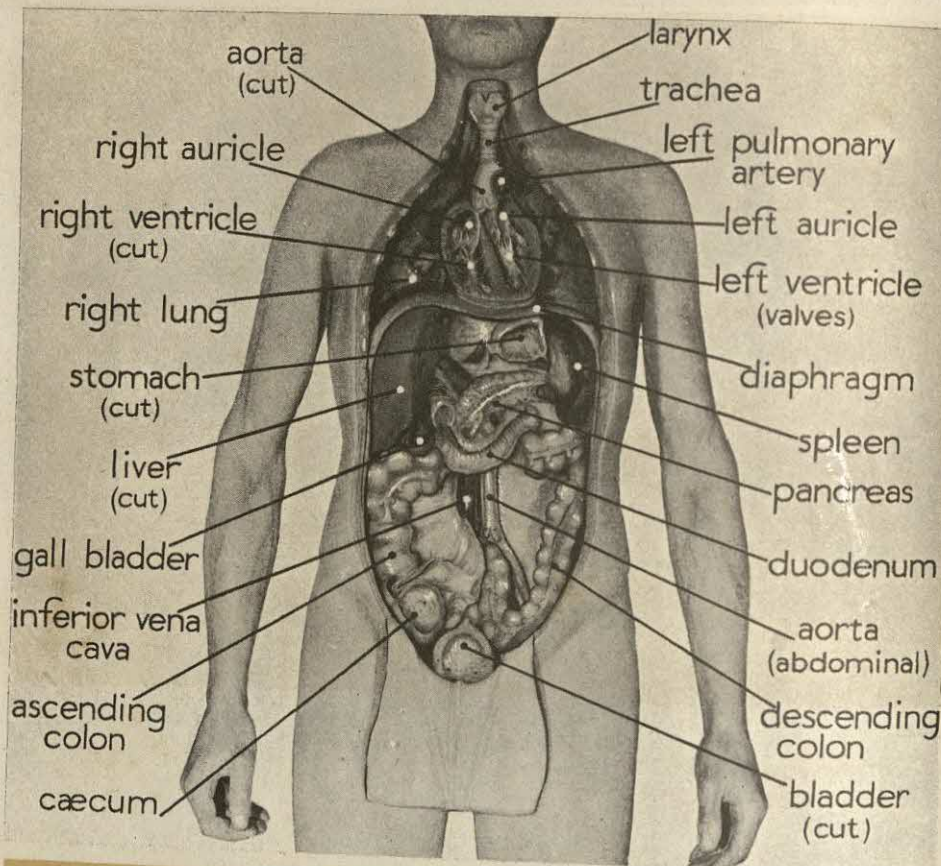
A FRAMEWORK OF BONES SUPPORTS THE BODY—MUSCLES TIE IT TOGETHER
The skeleton (left) is the foundation of our bodies. The muscular fabric (right) controls it.

Greeks, but his ideas of the body as a whole were vague, as he based those ideas on his study of lower animals. Aristotle, the wise philosopher of Athens, is considered the founder of comparative anatomy.

Scientific study of anatomy flourished in Alexandria, Egypt, after the death of Alexander the Great (323 B. C.). His successors,

the Ptolemies, made Alexandria the center of learning for the whole world, and here the human body was both dissected and described. Some of the names then used are found in our modern textbooks.

Under the Roman Empire, the study of anatomy made great progress. Galen (about A. D. 200), the most noted anatomist



Courtesy American Museum of Natural History

MACHINERY IN THE HUMAN FACTORY

This model of a man shows the organs with which our bodies take care of the food we eat and the air we breathe. The heart (top, center) keeps it all going.

of antiquity, proved that the arteries contain blood, not air, as earlier physicians believed. Galen was surgeon to the gladiators, who fought in the Roman stadiums, and he gained his ideas by observing the bleeding wounds of the fighters.

After the downfall of Rome, anatomy and medicine were cultivated by the Arabians and Saracens, but their progress was hindered by their religious beliefs, which forbade dissections of the human body.

The fourteenth century witnessed the return of learning to Italy, where several schools of medicine arose and where, owing to the practice of human dissection, anatomy was advanced to a level heretofore

unknown. At this period the rest of Europe still remained in relative darkness, and when in France, as late as the sixteenth century, medicine was cultivated with some degree of enlightenment, the study of human anatomy was still unknown.

The most remarkable impetus ever given to anatomy was at the hands of the renowned Vesalius, a native of Brussels. Vesalius was first educated in the University of Louvain, after which he continued his studies under Dubois, in Paris. Dissatisfied with the hampering restrictions placed upon anatomy in Paris, Vesalius went to Italy, and after years of devoted study, published his great work on



THIS IS A FEAST FOR THE DEAD

Chinese ancestor worshippers offering ceremonial food to their forefathers in a graveyard.

anatomy, the first comprehensive and systematic publication on this subject.

The succeeding anatomists of note were mainly Italians, until Harvey of England, after studying in Padua, announced in 1619 the circulation of the blood. In the next century many distinguished anatomists appeared in Italy, England, and Holland. In England, owing to the influence of William Hunter (born 1718), the dissection of the human body was made an essential part of medical training.

During the past century, investigations in the anatomy of the human body have been so thorough that it would seem as if by now there was little left to learn. Yet men of science continue to gain knowledge about the body. Most of their discoveries are made with the microscope, and most of them now concern the functions of the different parts of the body—that is, they are physiological as well as anatomical studies. In recent years investigators have been particularly interested in the study of glands, the wonderful regulators of the body. See GLANDS.

AN'CESTOR WORSHIP. The widespread belief that man's spirit is immortal, and that it advances toward a heavenly state, leads to a general respect for the dead. Because the ancestral dead might be supposed to influence the affairs of their descendants, respect, among certain peoples, has developed into worship. Some forms of ancestor worship, such as the Hindu, have elaborate rules for observance. Some forms of it include gifts, or sacrifices, intended to secure the protection of dead ancestors or to ward off any harm that they might bring to the worshippers.

The worship of ancestors is common among many primitive peoples, and some of them, like the early Romans, clung to the belief after reaching a more civilized state of society. It is seldom the only form of religious practice, even where faith in it is strongest.

The Chinese have worshiped their ancestors for centuries. In some Chinese houses, ceremonial wooden tablets, regarded as the home of departed ancestors, are hung on the wall, and the rites of wor-

ship are conducted before these. The Chinese code of ancestor worship includes the payment of debts left standing by a dead ancestor, and insists upon burial among those earlier relatives who have died. This is the reason that, when Chinese people die in a foreign land, their bones are returned to China for burial at a later date.

The people of Japan also practice ancestor worship.

ANDERSEN, *ahn'dur s'n*, HANS CHRISTIAN (1805-1875). Children and adults alike love the beautiful stories of Hans Christian Andersen. His fairy tales, *The Ugly Duckling*, *The Fir Tree*, *The Constant Tin Soldier*, *The Tinder Box*, *The Red Shoes*, and others, remain the best of their kind in world literature. Today they are as popular as they were in the nineteenth century, when everyone waited for the next one to come from the author's pen.

Fame did not come easily to Andersen. Born in poverty, in Odense, Denmark, Hans received little schooling when he was young. He had to go to work at an early age, but in his spare time he studied to get an education. When he was four-teen years old, the boy went to Copenhagen, where he hoped to become a great dramatist. The young Andersen had seen every play that came to his native town, and he vowed that he would write dramas which would be enjoyed by thousands of people.

For a long time Andersen wrote nothing important, but interested friends helped him to continue his education, first at a government school and then at the university, where he wrote a fairly popular book of poetry. Later, the king granted him a pension, so that he could travel. He wrote several books that the critics did not care for, but after 1835, when his first volume of *Fairy Tales* was published, he became the favorite writer of all who love this type of story. A statue honoring the author was erected in one of the public squares of Copenhagen.

ANDES, *an' deez*. Extending along the western coast of South America for a distance of 4,500 miles, the Andes form the longest mountain system in the world, and they raise their snow-capped peaks to heights surpassed only by the lofty Himalayas in Asia. There are about thirty live volcanoes in the Andean range, and earthquakes are common, often destroying whole villages.

The high and difficult passes have challenged the skill of engineers who have had to build bridges and roads through the mountain gaps, often under extremes of frigid weather. But the Andes offer rich rewards to those who overcome these hazards, for they have a wealth of gold, silver, copper, platinum, mercury, tin, lead, and iron. Fur-bearing animals and valuable plants are also found in abundance on their rugged slopes.

The Andes do not form an unbroken chain parallel with the coast, but they are a vast system of major and minor ranges which may be grouped into three main divisions—the Southern, Central, and Northern. The Southern Andes extend from the tip of South America at Cape Horn to the northern part of Argentina; Mount Aconcagua, an extinct volcano near the western border of that country, is the crest of the entire continent, rising about 23,000 feet above the sea. The Southern Andes consist of a principal chain and a minor chain running parallel to it on the east.

Extending north of the Southern Andes to Southern Colombia is the Central Andean division, a complicated system of ranges and lofty plateaus. This section has great stores of mineral wealth, and includes the fertile pampas of Peru and Ecuador and the lofty plateau system of Bolivia. A double chain of the Central Andes encloses these elevated plains. The entire Andean system has its widest extent across the Peruvian and Bolivian plateaus, at about 12,000 feet above the sea.

Prominent peaks of the plateau area include Illampu, Sahama, and Illimani, all



Ewing Galloway

A SYMBOL OF PEACE BETWEEN TWO NATIONS

The Christ of the Andes (above) was erected by Argentina and Chile to mark their boundary agreement of 1902. The bronze statue has one arm extended in blessing over the borders of the two countries.

over 21,000 feet high. The double range draws together farther north in Ecuador, where most of the volcanoes are found. Sangay (17,460 feet) and Cotopaxi (19,550 feet) are active volcanoes of this region, and the highest mountain summits include Chimborazo (20,581 feet), Antisana (19,260 feet), and Cayambe (19,200 feet).

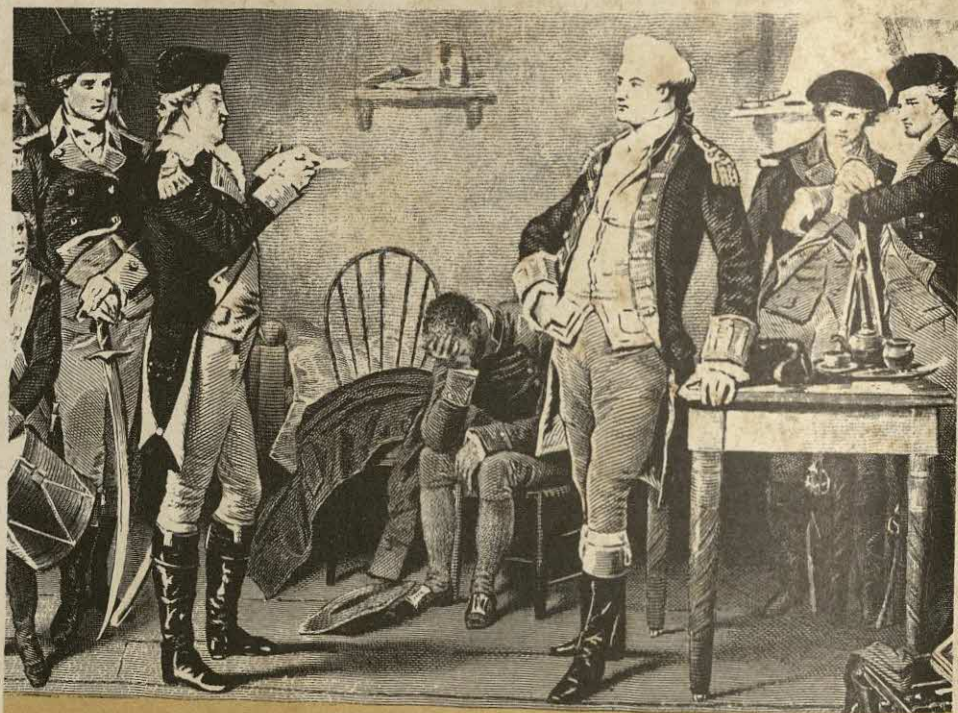
The Andes break into three separate parts farther north: a western range extending through the Isthmus of Panama; a central chain separated from the western by a long narrow valley; and an eastern range extending into Venezuela. The highest peak of the Northern Andes is Santa Marta, over 19,000 feet in altitude.

Not only are the passes through the mountains far above sea level, but the towns in the mountains are among the highest in the world. The silver-mining town of Cerro de Pasco, for example, is located more than 14,000 feet above sea level. One of the most famous of the high Andean passes is Uspallata, connecting

Chile and Argentina. A monument has been erected here to honor the settlement of a boundary dispute between the two nations. It is called "the Christ of the Andes," and is dedicated to international peace. See ARGENTINA.

ANDOR'RA. Far up in the Pyrenees, the mountain range that separates France and Spain, there is a tiny republic called Andorra. Consisting of only 191 square miles, it is one of the smallest states in the world, yet is five times the size of the republic of San Marino, in Italy. Andorra is one of the oldest republics, as its people have had self-government for over 600 years. They manufacture coarse cloth, raise cattle and sheep, cultivate vines and fruit trees, and work in the iron mines of the region.

The country has its own civil and criminal codes, and its own courts. There is a legislative body, or Council, of twenty-four members, elected by the male voters for four-year terms. Two judges, one chosen



THE VERDICT IS DEATH

Major John André, Great Britain's ace spy during the American Revolution, listens unflinchingly to the reading of his death sentence. He was hanged at Tappan, N. Y., in 1780.

by France, and the other by the Bishop of Urgel, in Spain, administer the laws. The village of Andorra, the capital, has a population of 1,000 and the entire country has about 6,000 inhabitants.

ANDRÉ, *ahn' dray*, JOHN (1751-1780). The dangerous rôle of a spy, played by this British soldier in the Revolutionary War, brought him death by hanging. As a member of the British Royal Fusiliers he came to Canada at the beginning of the Revolution, and in the first year of fighting was taken prisoner by the Americans. After being exchanged, André was promoted to the rank of major, and in 1780 he was sent by General Clinton to confer with Benedict Arnold.

This American general, a traitor to the cause, had offered the British the plans of the fortifications of West Point. Major André was captured by three American troopers while he was trying to get back to the British lines. He had on citizen's

clothing, but the Americans searched him and found the plans in his boots. After being tried by court-martial, he was executed as a spy.

While General Washington respected the soldierly qualities of Major André, he had the sentence carried out as a lesson to the colonies and Great Britain. A tablet has been erected in Westminster Abbey to the memory of the English soldier who died for his country just as truly as though he had been killed in battle.

ANDREW. Originally a disciple of John the Baptist, Andrew was one of the first of the disciples of Jesus. He was a brother of Simon Peter, and, like him, a fisherman of Galilee. It is believed that he preached in cities of the Holy Land and the Near East.

ANESTHETIC, *an es thet' ik*. Gases and drugs used to cause the loss of bodily sensation are called anesthetics; they are substances such as the dentist uses when

he wants to keep from hurting a patient. The absence of feeling caused by such substances is known as *anesthesia*.

When the natives of South America went on long, hard marches through the hot, tropical forests, they were accustomed to chew the leaves of the coca shrub to relieve fatigue or pain. Spanish explorers noticed this habit and found that these leaves contained the drug cocaine, which would deaden pain. This was the first known use of cocaine as an anesthetic.

The value of laughing gas in deadening feeling was discovered by Sir Humphry Davy in 1800. He was experimenting with nitrous oxide and found that, when it was inhaled, it produced insensibility. It was called laughing gas because, when the person who had inhaled it recovered consciousness, he would laugh hysterically for a time. Michael Faraday found that sulphuric ether had anesthetic properties. The first successful use of ether in an operation was by Dr. Crawford W. Long of Georgia in 1842 when he removed a tumor from a neck. In 1847, Sir James Y. Simpson, a Scottish physician, used chloroform in operations.

Ether and chloroform are very much alike in their general effects, but physicians have to guard against certain hazards in their use. Chloroform has a tendency to weaken the action of the heart, while ether has nauseating after-effects and is irritating to the air passages and kidneys. These drugs are spoken of as general anesthetics because they produce complete insensibility



Courtesy Metro-Goldwyn-Mayer

THE ANESTHETIST MAKES THIS OPERATION POSSIBLE
He is the man at the right, whose anesthetics kill the pain of surgery.

or unconsciousness. Local anesthetics are often used when the surgeon wishes to perform operations on a small area.

General anesthesia occurs, to some extent, in sleep; it also accompanies coma, shock, exposure to gases, and poisoning from certain drugs. Local anesthesia can be produced, in some degree, by obstructing the circulation in the parts affected. The sensory nerves of the skin and mucous membranes are like electric wires; they convey messages of pain, or other sensation, to a central station, the brain. If, however, the lines of communication are blocked, or cut off, no pain is felt. General anesthetics act upon the central nervous system, while local anesthetics, for the most part, are made use of to stop sensation at the ends of nerves.

Local anesthesia is produced in three ways: by dissolving the drug and applying it to mucous surfaces; by injecting it into the tissues hypodermically; or by injecting it into the sheath of the spinal cord. Novocaine, stovain, eucaïne, cocaine, and alypin are the agents most employed for local

anesthesia. Cocaine was the first used; the others have been developed as substitutes.

In recent years valuable new anesthetics have been developed. Ethylene, since 1923, has held a high place in dentistry and surgery. Its advantage over ether is that it does not produce the sickening after-effects usually experienced with ether.

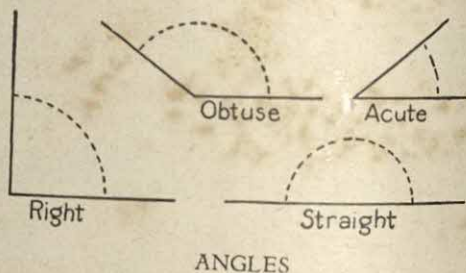
ANGELICO, *an jel' i ko*, FRA (1387-1455). At the close of the Middle Ages there lived in Italy a Dominican friar who is honored today as one of the greatest of religious painters. His real name was Guido da Vecchio. When, in 1408, he took his religious vows in the convent at Fiesole, he received the name Fra Giovanni da Fiesole (Brother John of Fiesole). As a painter, however, he is universally known as Fra Angelico, "the Angelic Brother," for the spiritual quality of his paintings was a reflection of his piety and goodness. It is said that he always prayed before taking up his brush. He worked not only in Fiesole, but in Florence and Rome; some of his finest paintings were done at the order of Pope Eugenius IV.

Those fortunate enough to visit the city of Florence may see there, in the National Museum of San Marco, Fra Angelico's greatest frescoes, *Crucifixion*, *Transfiguration*, *Madonna of the Star*, and many others. Near the close of his life, the friar painter decorated for Pope Nicholas V the latter's private chapel in the Vatican, Rome. Examples of his work are found today in the Louvre, the London National Gallery, the Metropolitan Museum in New York, and many other galleries. Fra Angelico was renowned as a colorist, and he was one of the first artists to give naturalness to the Virgin and the Christ Child.

ANGLE. Although this word has come down to us in a number of different forms, it has called forth the same association of ideas in all its various spellings. The Greek *ankos* meant a bend, or hollow. In old England, the word assumed the present spelling, angle, but it meant a fishhook, or any other bent object, such as an anchor. In the commonest modern

sense, an angle is a figure made by the intersection of two straight lines at a point, or the space bounded, on two sides only, by these straight lines.

To visualize the mathematical meaning of angle, fasten one end of each of two pieces of string on a table with a thumb tack, *O*. Also fasten the other end of one of the strings, *A*. Now move the free end of the other string, *B*, holding it taut, to a position several inches from *A*. Then the space between the strings *OA* and *OB* is an angle, known as the angle *AOB*. (See illustration.)



ANGLES

In other words, an angle is the amount of turning of one straight line from another which intersects the first in a point called the *vertex*. This is known as a *plane* angle, for the portion between the sides of the angle is a plane, or flat surface like the table top.

The size of a plane angle depends on the relative direction of its sides. If they differ widely in direction, the angle is large. The size of the angle is measured in *degrees*, a degree being $1/360$ of the distance around a circle. Therefore the number of degrees of an angle is the number of degrees in the section of a circle which could be drawn from one side of the angle to the other, using the vertex of the angle as center.

A *right* angle is an angle of 90° .

An *acute* angle is an angle of less than 90° .

An *obtuse* angle is one of more than 90° and less than 180° .

A *straight* angle looks like a straight line, but it is an angle in which one side has turned 180° from the other.



SAXONS LEARNING THE CHRISTIAN FAITH

In the year 597, a band of forty monks, led by Saint Augustine, landed in Britain and, in a very short time, reported to Pope Gregory that they had converted 10,000 persons to Christianity. In the illustration, Saint Augustine is seen preaching to a group of Saxons, who had formerly worshiped Woden, regarded by them as chief of their gods.

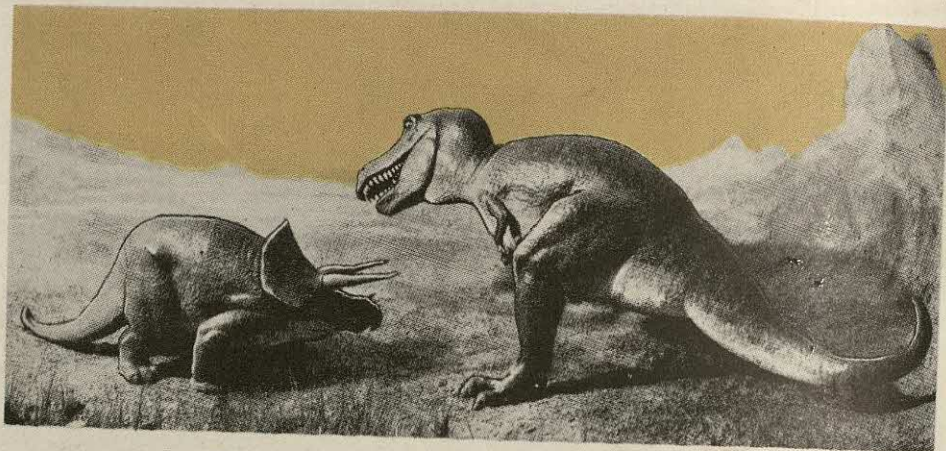
ANGLES. This Low German tribe which crossed over to Britain in the fifth century has bequeathed its name to one of the greatest countries in history. Their *Angle-land* has become *England*. Before they migrated to the British Isles, the Angles lived in the lowland district of Schleswig, south of Denmark, in Northern Europe. Bands of Saxons and Jutes accompanied them to Britain, the three tribes colonizing most of England and a part of the Lowlands of Scotland. The Angles were in the majority, among the Germanic settlers on the island, and founded the three kingdoms of East Anglia, Mercia, and Northumbria. See **ANGLO-SAXONS**; **ENGLAND**; **SCHLESWIG-HOLSTEIN**.

ANGLING. See **FISHING**.

ANGLO-SAXONS. In the fifth and sixth centuries, when the Angles, Saxons,

Jutes, and other German tribes crossed over to Britain and there intermingled, they formed the race of Anglo-Saxons. These sea rovers, who settled in the best parts of the country, pushing the native Britons back into the hills, became the ancestors of most of the English-speaking peoples of today. The Anglo-Saxons' king, the chief noble, was chosen by the people. Their traditional occupations were agriculture, hunting, and fishing. See **ENGLAND**; **ENGLISH LANGUAGE**.

ANGOLA. This Portuguese overseas province in West Africa is the largest of all the Portuguese overseas possessions. It has an area of 482,000 square miles and a population of 4,000,000. Agriculture is the chief occupation, but diamonds, copper, gold, and managanese are found there, and industries have been developed.



A TITANIC STRUGGLE BEFORE THE COMING OF MAN

The deadly *Tyrannosaurus*, king of prehistoric reptiles, attacks the smaller *Triceratops*.

ANILINE, *an' il in*. Brilliant colors—blue, red, yellow, green, violet, and many others—make our clothes more attractive. Colored paints and varnishes add beauty to our rooms. Many of these colors are made from aniline, a liquid which a young English chemist accidentally found to be an excellent dye base. While William H. Perkin was trying to make artificial quinine out of aniline, he obtained instead violet dye of unusual beauty. Since this first aniline dye was made, chemists have experimented until they have learned to make aniline dyes of almost every color.

Aniline is a colorless, oily liquid, somewhat heavier than water. It has a peculiar odor and a burning taste. It is found in small quantities in coal tar, but is commercially prepared from benzene or benzol. When benzene is treated with nitric acid it produces nitrobenzene. At the same time, this compound is treated with hydrogen. The final product, aniline, is a compound composed of hydrogen, nitrogen, and carbon.

Valuable as a base for fabric dyes, aniline is also in demand for the manufacture of inks, varnishes, and paints. Nitrated aniline is an explosive used in mining and in the construction of torpedoes. It also enters into the manufacture of certain drugs and disinfectants. See **COAL TAR**; **DYEING**.

ANIMAL. Although we all know that there is a difference between a plant and an animal, it is not so easy to say what the difference is. If we study the simpler forms of plants and animals, it is even less easy. We might say of the cow that it moves about as "an animal does" or of the potato that it is green "like a plant," but there are plants that move about and animals that are green. There are, however, some differences which can be more or less definitely set down.

Structure. The general form of the body of an animal of a given species is usually invariable. For example, the form of body in all horses is usually the same and the form of body in an oyster is usually quite like that of other oysters. In plants, however, there may be considerable variation in the form and shape of different individuals of the same species. We can say that any horse has four legs, two eyes, two nostrils, and so on, but we cannot say how many branches or leaves a plant has without seeing it.

The organs in animals are usually much more compact than they are in plants, and in animals they are mostly internal, while in plants new ones are added externally.

Locomotion and Feeling. In general, the ability of adult creatures to move about is more or less limited to members of the animal kingdom and is uncommon in

plants. Some adult animals, including oysters, do not move about, even though in the earlier stages of their life history they can do so to a greater or less extent.

If we stick a pin into a cow we immediately know that the cow is aware of it. On the other hand, we can stick a potato full of pins and get no indication that the potato is aware of anything. The difference is accounted for by the fact that plants have no regular nervous system, while the more highly elaborated animals do.

Nourishment. There is one difference more important than any yet named. This difference has to do with the method of getting food, the kind of foods demanded, and the disposition of the foods.

The possession of green color, due to a material known as *chlorophyll*, usually is sufficient indication that a living thing is a plant. Animals do not possess chlorophyll, and most plants do. Chlorophyll is a substance which is able in the presence of sunlight to combine water and carbon dioxide from the air and eventually to form starches out of them. In the process another gas, oxygen, is freed. The production of these starches is all-important to all

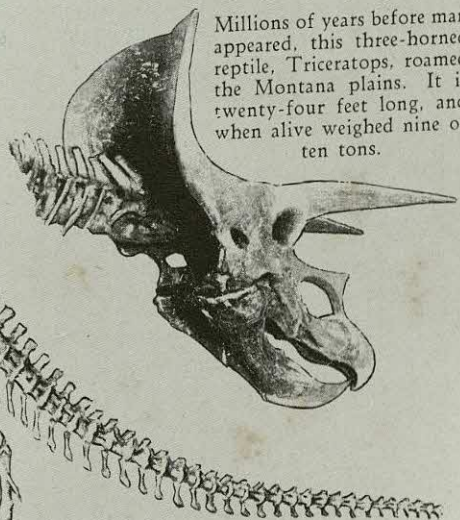
living things, because without them there would be no living things. The plants themselves use them in increasing their own bodily stature. Animals get them by eating plants. Consequently, animals are wholly dependent upon plants for their starchy foods.

Not only do plants and animals differ in their foods, but they also differ in the products which they cast off as wastes. In the destruction of plant foods in their bodies, animals return to the air carbon dioxide, the same gas which the plants used in making these foods. In making these foods the plants take energy for themselves. From this it may be seen that, in a way, the food problem is a sort of "teeter" in which the plants build up foods and the animals tear them down. If animals are to live, they must continue tearing down foods, and if animals are to tear foods down continually, plants must continually build them up.

Not all of the foods taken into animals are used. There are parts that are rejected and these parts may frequently be solid matter. Plants cannot give off solid matter as waste products, and here lies another difference.



No human being ever saw the *Tyrannosaurus* alive, but its bones have been dug up and the skeleton formed, proving it to have been the largest of flesh-eating creatures.



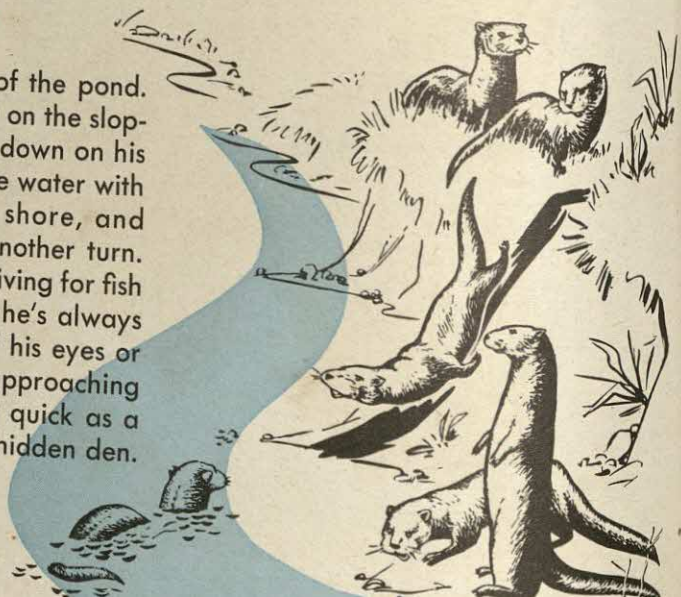
Millions of years before man appeared, this three-horned reptile, *Triceratops*, roamed the Montana plains. It is twenty-four feet long, and when alive weighed nine or ten tons.



verhaeuser Timber Company

ANIMALS ON THE ALERT

The otter is the playboy of the pond. He makes a slide of wet mud on the sloping bank and goes shooting down on his furry stomach. He lands in the water with a splash, swims quickly to shore, and scampers up the slope for another turn. But whether he's playing or diving for fish or sunning himself on a log, he's always on the lookout for danger. If his eyes or ears or nose warn him of approaching trouble, he slips under water quick as a flash and takes refuge in his hidden den.



The buffalo was alert, but he wasn't very bright, and he wasn't fast enough to outrun swift horses or arrows or rifle bullets. So men almost killed off the buffalo before they decided to protect those that remained from hunters.



ANIMAL SUPERSTITIONS



**ELEPHANTS
DO NOT**
Fear Mice



**SNAKES
DO NOT**

Roll Like
Hoops



**CRANES
DO NOT**

Carry Hummingbirds
on Their Backs



**OSTRICHES
DO NOT**

Bury Their
Heads in the
Sand

**PORCUPINES
DO NOT**

Shoot Their
Quills When
Angry



**NIGHTINGALES
DO NOT**

Sing Only
at Night



**HIPPOPOTAMUSES
DO NOT**

Sweat Blood



Fable and legend have perpetuated many beliefs about animals which are now known not to be true. Here are some of the more familiar of these superstitions about animals.

How Animals Live. While animals are of many kinds and while they differ from plants in many ways, they do have certain things in common. Animals breathe rapidly under some circumstances and slowly under others, to get energy from the food that they have eaten. If conditions are such that they need a great deal of energy, they breathe more rapidly. This need of air by all animals is universal, though some need it in smaller quantities than others.

Animals also eat more or less regularly. If they did not, they would not be able to live. All animals must change the food which they take into their bodies into some form in which it can be used in the body. This alteration of the food is digestion. The mere preparation of food is not all that is necessary. A meal which is prepared will do no one good unless it is eaten. And even if it is eaten and further prepared for use in the stomach and elsewhere, it will not be of value unless it is taken up into the body and made into the body itself. This taking up of food into animal bodies is known as assimilation, and assimilation is common to all animals.

The act of getting rid of materials which are not used is important, as well as the using of desirable materials as food. All animals rid their bodies of waste products in the act known as excretion.

Plants as well as animals breathe, or respire. They also digest their foods and assimilate them. They are not, however, able to rid their bodies of solid wastes.

The Kinds of Animals. There are many different kinds of animals at present living on the earth. In the scientific world these forms have for convenience been arranged in groups, the members of each of which have one or more characteristics in common. Probably no one person will ever be able to know and recognize the members of all the groups, but it is not very difficult for any one to recognize the group to which any common animal belongs.

Men are conceited enough to believe that they represent the highest form of life on the earth, and to compare other animals with themselves. We have backbones and spinal cords. But we are not the only animals that have these structures. The other animals having backbones are placed with ourselves in a group known as the *vertebrates*.

Since the animals in this group are quite varied, we are able to recognize differences and similarities among the vertebrates and thus make smaller groups. One is the *mammals*, which have more or less hair, as we do; another is the *birds*, which have feathers; another, the *reptiles*, whose bodies are usually covered with scales and who breathe by means of lungs; another, the *amphibians*, or *batrachians*, whose bodies do not usually possess scales and who breathe part of their lives by gills and may breathe part of their lives by means of lungs; and another the *fishes*, whose bodies are usually covered with scales and who usually breathe by means of gills.

Most of us are familiar with members of each of these groups. We have chased squirrels and woodchucks, which are mammals, and have watched birds of many sorts building their nests. We have perhaps foolishly fled from snakes, which are reptiles, or played with lizards or turtles, which also are reptiles. We have heard and seen frogs and some of us have seen salamanders, which with the frogs are the commonest kind of amphibians. And we have all caught or eaten fish.

It is not so easy to call to mind animals which have no backbones. There are some which have a spinal cord like man, but have no backbone, but we do not see members of this group very frequently. With the vertebrates, they belong to a group known as the *Chordata*.

Among the other animals than those which have spinal cords and backbones is one group which has many familiar representatives. To this group belong insects, lobsters, spiders, millipedes, and their rela-



As she hunts for berries with her cubs, the fat mother brown bear seems lazy and peaceful. But actually she is as wary and watchful as the Rocky Mountain goat, perched on a lonely, lofty crag.

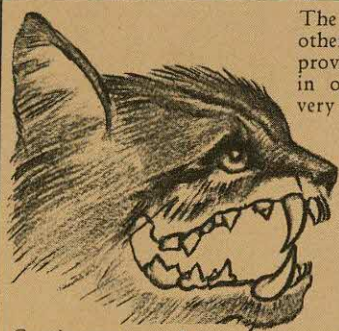
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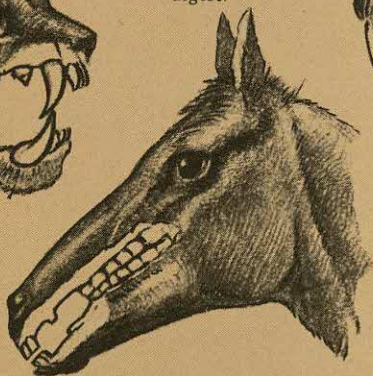


THE FIERCE GORILLA MEETS AN ANCIENT ENEMY

Nature gave the gorilla a fierce temper and tremendous strength to defend himself against his enemies. A blow from his powerful arm can kill a man. Life in the jungle is a continuous struggle for existence, in which the weak or sick are rapidly eliminated. Nature has provided some means of self-defense for each creature.



Carnivorous or flesh-eating animals, such as the wild cat (above), have sharp, pointed teeth, including four long fangs or seizing teeth, with which they grasp their prey.



The horse (below), cow, and other grass-eating animals are provided with short, flat teeth in order to grind their food very small, making it easier to digest.



All rodents including the guinea pig (above), mouse, and muskrat are fitted with chisel-like teeth, especially suited to gnawing. There are several thousand species of rodents, varying in size from the mouse to the capybara, four feet in length.

tives. All of these are creatures which have jointed feet, or appendages, and have their bodies divided into a single row of segments or sections. The members of this group are said to be *arthropods*. Their name refers to their jointed feet.

Then there is a group of animals whose bodies are frequently protected by hard shells like clam shells. Its most familiar representatives are oysters, clams, mussels, scallops, cuttlefish, and snails. Some of the members of the group do not have shells, but are so much like the shellfish that they are placed in the same group. The members of this group are known as the *mollusks*, or *Mollusca*. Most mollusks move about on a single muscular structure known as a *foot*, by a series of extensions and contractions.

The earthworm is a well-known member of the group known as the *Annelida*, or *Annulata*. The members of this group are long and wormlike and their bodies are made up of ringlike segments. The leeches which get between our toes when we go swimming are also members of this group of wormlike animals.

Starfish and sea urchins are spiny-skinned creatures, the parts of whose bodies are grouped around a central area. They are *echinoderms*.

There are certain roundworms which

look not unlike animated horsehairs. The resemblance is such that it is not surprising that people have believed that the creatures really did come from horsehairs. These roundworms belong to a group spoken of by scientists as the *nemathelminths*, the most important class of which is the *nematodes*, or roundworms proper. Many of the nematodes live as parasites on animals and plants.

There is another group of animals which includes many animals living as parasites on other animals. This is the flatworm group, or the *platyhelminths*. This group includes, besides the well-known tapeworms, the liver flukes which cause the death of large numbers of sheep.

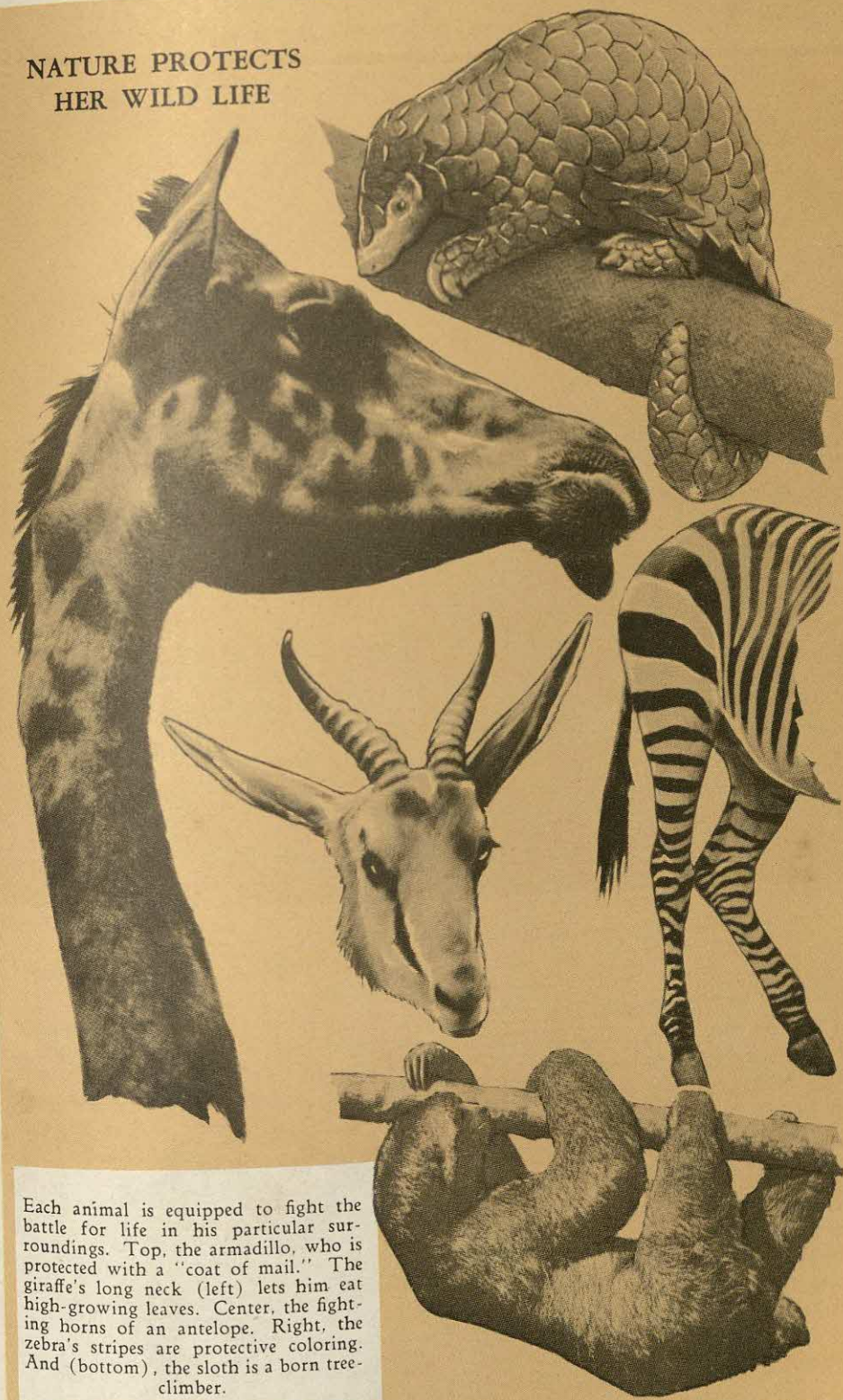
Another group includes the jellyfish and the animals which are responsible for the coral islands of the world. This group is known as the *coelenterates*.

Still another group, very few of which are found in fresh water, includes, among other animals, those whose skeletons are made up into sponges. This group is the *Porifera*.

The other large and important group is made up of small, but significant animals. Most of them are so small that they may be seen only with a microscope. The group is known as the *Protozoa*.

Animals and Man. At every turn in

NATURE PROTECTS HER WILD LIFE

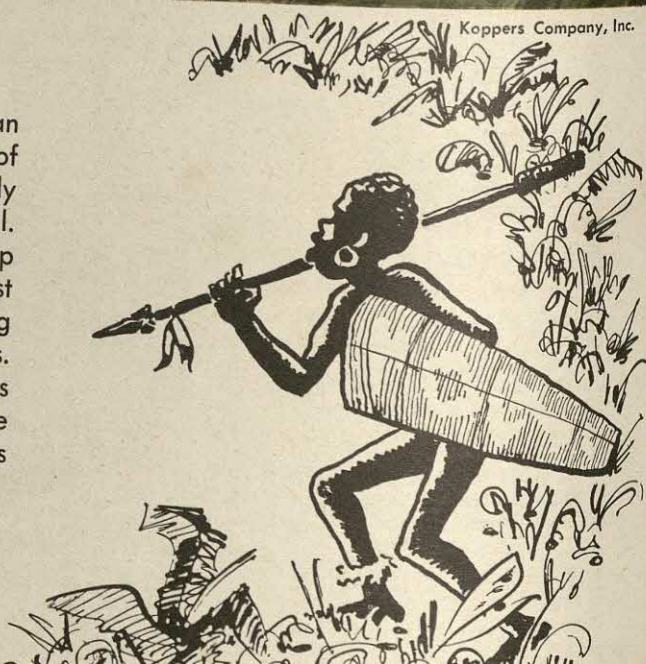


Each animal is equipped to fight the battle for life in his particular surroundings. Top, the armadillo, who is protected with a "coat of mail." The giraffe's long neck (left) lets him eat high-growing leaves. Center, the fighting horns of an antelope. Right, the zebra's stripes are protective coloring. And (bottom), the sloth is a born tree-climber.



Keppers Company, Inc.

The huge ears of the African elephant do not warn him of approaching danger as quickly as does his keen sense of smell. When his waving trunk picks up the scent of man, the great beast may disappear silently among the trees or into the deep grass. But he may charge out upon his enemy, crashing through the underbrush and trumpeting his mighty wrath.



life, man finds himself dealing with creatures of the animal world. Some provide him with food and clothing, some work for him, a few are beloved companions, and a considerable number are deadly enemies. Many others are interesting objects of study. On farms and ranches and in woods and waters are the animals that feed and clothe the world—pigs, cows, chickens, fur- and wool-bearers, game and fish.

The camel of the desert, the elephant of India, the reindeer of the Arctic regions, the oxen of Old China, and the horse of the white man are typical of the faithful creatures that serve man as burden bearers, draft animals, and means of transport. Birds, dogs, and cats are favorite pets the world over. And there are animals that provide sport and amusement—polo and race horses, the trained animals of the circus, the odd and interesting creatures of the zoo. In the insect world are hosts of small creatures that carry disease or destroy crops. As in the plant world, the great animal family is made up of individuals of infinite variety, value, and interest.

In these volumes may be found articles on numerous animals and groups of animals, as well as articles on their products.

ANNAPOLIS, *an ap'o lis*, Md. An historic city of Maryland, Annapolis is famous today as the home of the United States Naval Academy, where selected young men are trained as officers for the United States Navy. This picturesque Chesapeake Bay community attracts many visitors, who come to see the midshipmen's parades and inspect the town's quaint streets and landmarks of colonial days. It is only a half hour's run by car from either Washington or Baltimore.

Annapolis was originally settled by Puritans from Virginia, in 1649, under the name of Providence. It was renamed in honor of Queen Anne of England, in 1694, and became the capital of the province. Since 1788 it has been the capital of the state. One of the tourist shrines here is

the venerable State House, built in 1772, where one of the first sessions of Congress was held in 1783, and where, on December 23 of the same year, Washington resigned as commander in chief of the Continental Army.

Succulent oysters and choice fruits from Maryland are sought after in Eastern markets, and the business of Annapolis centers around the harvesting and shipment of these delicacies. The population is about 13,000. See NAVAL ACADEMY.

ANNE, *an* (1665-1714). During the reign of Anne, queen of England and Scotland from 1702 to 1714, British power was notably asserted in Europe. The War of the Spanish Succession led to the seizure by England of Gibraltar, the gateway to the Mediterranean Sea. Also, while Anne occupied the throne, Scotland united with England to form Great Britain.

Although Great Britain became a great power during her short reign, Queen Anne was hardly considered a strong ruler. She was influenced by the Duke of Marlborough, his wife, and other powers behind the throne. She was the last of the Stuart rulers in England, the second daughter of James II. She married Prince George, brother of Christian V of Denmark, and was a follower of the triumphal William of Orange who became William III of England when her father lost the throne. She succeeded William III at his death in 1702. Although Anne was the mother of many children, they all died in childhood.

In addition to the victories which England achieved on battlefield and sea, in the years of Anne's reign, great English writers gave distinction to the period, among them, Pope, Swift, Addison, Defoe, and Congreve. This era saw also the achievements of Berkeley and Newton in science and the strengthening of Britain's Cabinet form of government. See STUART; SUCCESSION WARS.

ANNEALING, *an eel' ing*. Imagine a room a block long—a modern annealing department in a large factory. High in the

air, rumbling along with whistle blowing noisily, an overhead crane moves toward one end. Swinging by cables below the crane cab, like a lamb in the claws of some gigantic bird, is a bundle of thin sheets of iron, piled man-high like pancakes. These sheets will be the hoods of bright new automobiles in a few days.

But not yet, for they were just born, squeezed out of terrifyingly noisy rollers that pressed them thin and flat from fat chunks of red-hot raw steel. They are headed now for their baptism in a row of ovens, each as big as the biggest room in your home. Next day, after these steel sheets have been heated to a cherry-red, soaked for hours at 1,600 degrees Fahrenheit, then cooled ever so slowly, they will be ready for the automobile factory. They will be *annealed*.

Annealing is an industrial process of slowly heating up materials, holding them at a high temperature, then slowly cooling them down. It is one of the steps necessary in making a great many different products out of iron or steel, or other substances. Annealing "does things" to the metal. Sometimes it "relaxes" the iron; for the metal in big iron or steel castings, such as engine frames, is all "tense" when first shaped, just like a stiffened hand. It has stretched itself tight while cooling and shrinking. When a mass of steel is in that condition, it may snap under a blow or strain. Therefore castings are usually annealed.

Other metal objects are annealed to make them softer. Then it is easier to plane or grind them down into desired shapes. Otherwise the metal would be too hard for the cutting tools.

Again, annealing is done because Nature dislikes to give steel all desired qualities at once. Very soft, bendable steel is not always strong enough. Strong or hard steel is likely to be brittle; the iron handle of a cheap toy pistol, for instance, is very hard, but it will break if you drop it on the walk. Annealing does magic tricks of making metals very strong and also easy

to shape into useful or artistic articles.

Wire is also annealed. By stretching, annealing, then stretching its wire some more, the wire factory can make "piano wire" that is tough and bendable, yet so strong that a single slender strand no bigger than a fence wire could lift a loaded coal truck without snapping. We would not have big suspension bridges if engineers had not developed annealing into almost a magic art. For the cables of these big bridges are just bundles of thousands of tough little annealed wires.

What is the secret of annealing? It is very simple. Slow heating, followed by slow cooling, changes the tiny grains of the steel. Before going into the oven, the metal as seen through a powerful microscope is like coarse-grained "sugary" fudge. After annealing, these grains are much finer and more even, like "creamy" smooth fudge.

When steel sheets are to be annealed, they are trundled into the ovens on small railroad cars. Sometimes the sheets are covered over by big iron hoods that seal them from air. This is done to prevent rust from forming and to preserve the mirror-like finish you often see on flat pieces of steel.

There are many different kinds of annealing furnaces. Some are so large that the wheels of big water-power turbines can be enclosed within them. Other annealing ovens are so small that they may be placed on a table; their tiny doors open to receive small objects set in place by hand.

If you ever visit one of the big automobile factories, you can see "continuous" ovens, through which axles and other parts move slowly on rollers, getting their baptism of fire on the run.

Furnaces for annealing wire usually have a door in the top. Coils of wire are put in big iron pots, which are then sealed tightly and lowered by a crane into the open doors.

In the big factories which turn out every sort of glass article, from beautiful stemware to baking dishes, annealing is a

"ONE FOR ALL, AND ALL FOR ONE"

necessary step in making these products durable. Goblets, bottles, flasks, and dishes all go into the *lehrs*, or annealing ovens, while still hot from shaping. Slowly their fierce heat is reduced as they travel through the *lehrs* on conveyors. When they come out at the cool end, they are much tougher, much less brittle, than the glass things grandmother used to break. Modern glassware lasts longer, and the credit goes largely to annealing.

If you ever visit a big steel mill or factory where machinery is made, it will be fun to see for yourself how annealing is done. It sounds very simple as described here, but really a great amount of skill is needed. The men who have worked around annealing ovens for years get to have an uncanny ability. They can often tell whether the oven is at the right temperature, just by peering through a little hole in the door. Even with the invention of electric thermometers, nothing can take the place of these experienced workers. See GLASS; IRON; STEEL; TEMPERING.

ANNUNZIO, *dahn noon'dze o*, GABRIELE D' (1864-1938). Poet, patriot, prince, Gabriele d'Annunzio is one of the great romantic figures of Italy. While still a youth, d'Annunzio began writing poems, and by the time he was twenty-six years old, he had published several volumes. He continued to write, branching out to novels and plays, and early in World War I wrote flaming verses that helped bring Italy into the war in 1915. He joined the colors, and became an aviator.

Some of d'Annunzio's best-known novels are *The Child of Pleasure*, *The In-*

truder, *The Flame of Life* (based on the author's romance with Eleanora Duse), and *Virgins of the Rocks*. His plays have met with but moderate success in the theater. One of them, *The Dead City*, was written for Sarah Bernhardt.

ANT. In the playground of a school of an Indiana city one afternoon, a group of children found a caterpillar mired in some sticky mud. Try as it would, the caterpillar could not escape from the black, gluey soil. The children noticed an ant hill eighteen feet away, and in a little while they saw a crew of ants making their way to the mud. The ants attacked the fuzzy victim, attempting to pull it out. The caterpillar resisted them, but as it did so, it sank deeper and deeper into the mire. Then the ants suddenly gave up their attack, as if by a signal.

Near by was a pile of sand, and the next thing the children saw was the ants carrying particles of sand out to the cater-



pillar and covering it up. When the children returned the next morning, the caterpillar had been smothered and cut into six equal parts, and the ants were carrying the pieces back to their home, where they stored them for food.

Social Citizens of the Soil. Anyone who will take time to watch the activities of a colony of ants will see similar examples of the way they live and work.

Is it simply instinct that gives them the power to overcome such obstacles, or are they able to reason?

Regardless of whether ants are wise or have highly developed instincts, it is true that they have a complex civilization not unlike ours in several ways. They belong to the highest order of insects, which includes

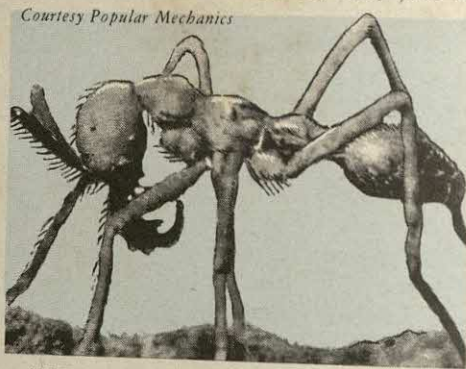
those other social insects, the bees and the wasps. Ants live together in harmony. They defend their comrades from intruders and care for their young. They assist the weaker members of the colony, and minister to those that are sick. They are industrious and persevering, and no task that they undertake is too difficult.

Ants live in underground cities of streets and tunnels that have storehouses for their food, nurseries for their young, and homes for their queens. They have a system of disposing of their refuse, just as large cities have, and they keep themselves clean and tidy. They even keep cows! Their cows are plant lice, or aphids, which they "milk" by stroking with their antennae. The ants herd these aphids from plant to plant to "graze." The liquid secreted by the aphids is a sweetish substance, called *honeydew*, which the lice have sucked from plants.

Ants can build bridges, form themselves

into an army, and play among themselves like puppies. Some colonies of ants nest in rotten tree trunks, but most ants found in the temperate regions live in the ground, burrowing a network of tunnels leading down from a funnel-shaped mound of earth on the surface. Some ants capture others and use them for slaves; but, just as in man's world, the captors usually become lazy and are overthrown.

Every Ant Born to One Task. The male ants live only a short time, and their only purpose is to mate with the queens. They do no work, and they either die after mating, or are killed by the workers before winter. The workers are undeveloped females, and far outnumber the males and



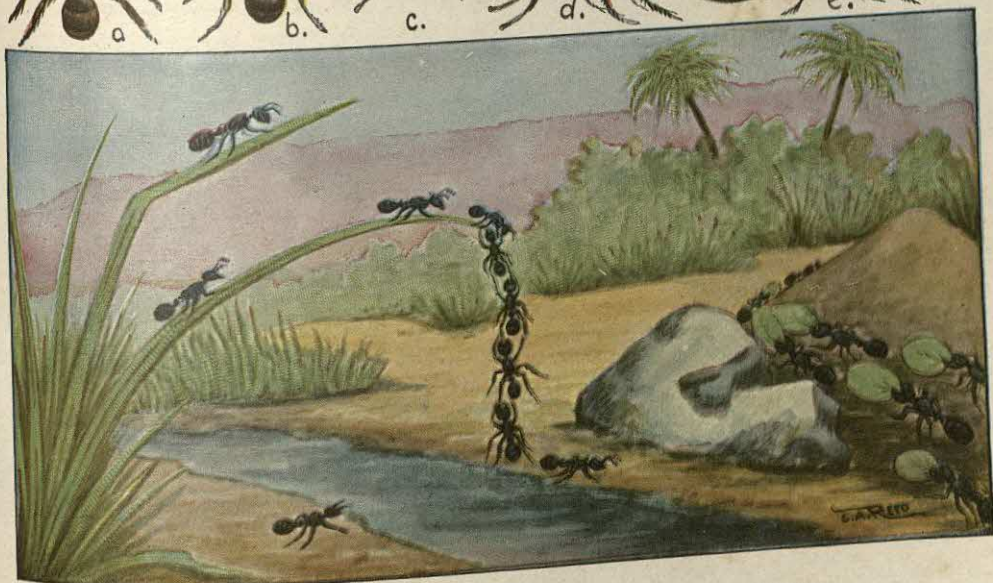
INSECT IN THE DAIRY BUSINESS!

Ants actually keep cows! They are a variety of plant lice called aphids, which the ant milks by stroking with its "feelers" or antennae. This causes the louse to excrete a sweetish liquid, which the ant eats with great satisfaction.

queens. They have no wings like the males, and neither do they lay eggs like the queens. They are also called neuters.

Theirs is a busy world. They bring food to the colony, prepare it, and do whatever fighting is necessary. They care for the eggs, larvae, and cocoons of the colony, move them about from one nursery to another, depending on the temperature, and take them out in the light for a daily airing. The workers feed the larvae, wait upon the queens, and keep the colony tidy like good little housekeepers. They live from four to seven years, sometimes in the same place all their lives.

Queens are the founders and rulers of ant colonies, although sometimes they are captured by workers from another colony and are taken to the nest of the marauders to live. Queens have been known to live through more than twelve summers. Early in the summer, on a bright and sunny day, there will be a great stir about the

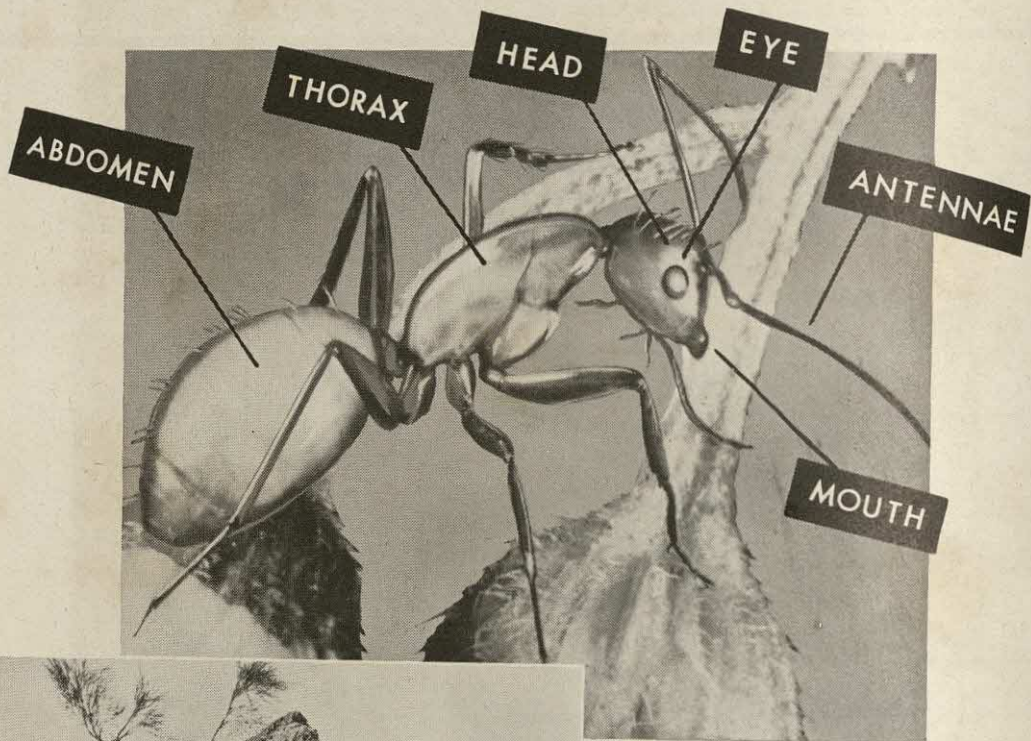


ANTS
Ant Hills

Ant War
Honey Ants
Ants and Plant Lice

On the March
Eggs
Larvæ

d. Winged Female; e. Male
Carrying Leaves



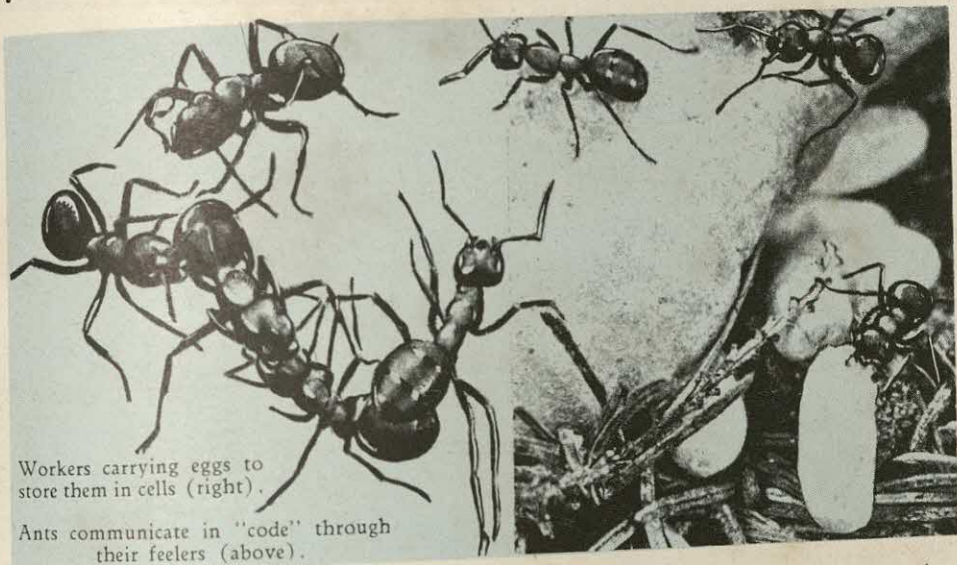
*Robt & Haas Company; Australian News
& Information Bureau; Grace Line*

PRINCIPAL PARTS OF THE ANT are shown above. Like other insects, the ant wears its skeleton on the outside.

GIANT ANTHILLS are built by tiny workers of both ant and termite colonies. This one is found in Northern Australia.

THE LITTLE ANTEATER of Ecuador catches ants with its long tongue.





Workers carrying eggs to store them in cells (right).

Ants communicate in "code" through their feelers (above).

ant hill. The young winged ants move restlessly until the queens take flight on their delicate, gauzy wings, followed by the males. This is the mating flight, impelled by instinct.

After a short time the queens and males return. The queens tear off their wings as a bride removes her veil, for they will never fly again. Now they crawl into the colony to start their lives of egg laying. They wear away their mandibles (jaws) by digging nests. The males, in the meantime, soon die. The queens do not eat for months after mating, but devote themselves to laying eggs. The first tiny larvae, as they hatch from the eggs, are fed a fluid from the queen's own body. The little grubs become cocoons, and when winter ends, these in turn become worker ants. The queen is now relieved by the small workers of every labor but egg laying. Both she and the eggs and larvae are cared for with tireless patience.

Specialized Physical Development.

Ants are very adaptable to any living conditions. They have been found in all climates and regions. In case of cold, they dig deeper into the ground. Rain or drought is hardly noticed and they can live a long time without food. In fact, a female can store enough food in her body

to live a whole year without ever eating.

Ants do not have very good eyes, because they live underground where it is dark. But they do have highly developed senses of touch and smell. The feelers, or antennae, connected to the head, can be moved about rapidly whenever the ant is finding its way about, or examining an object that arouses interest. The jaws, called mandibles, are the most useful part of the ant's head. They are used to carry loads; as saws to cut with, or as daggers in killing an enemy, or as spades for digging. The outer covering of ants is horny and tough, sometimes shiny, sometimes dull. Their tongues and antennae are used to keep themselves and their comrades neat and clean.

How Ants Make a Living. One of the main sources of nourishment of the ant is the milk from the plant lice. Some species of ants are meat eaters. They will pick the body of a dead mouse clean in a few hours. But most ants eat seeds, grain, and the fungus from bits of leaves which they store and cultivate in their colonies.

Plants often grow in a circle around an ant hill, leading to the belief that the little creatures are farmers. This is not the case, however, for the plants have merely sprung from seeds discarded by the ants.

At times, one may notice ants crawling along the ground, carrying a piece of leaf as if it were an umbrella. What this type of ant is doing is bringing the leaf to the colony, where it will be stored for fungus to grow upon. These ants are of the fungus-eating species.

Society Studied in a Tumbler. You can easily watch ants at work in your own home by building a *formicarium* (from the scientific family name of ants, *formicidae*). Take a large tumbler, and scoop up as much of an ant hill as you can. Place the ants and soil in the tumbler and surround it with a black covering to keep it dark. The tumbler should be placed in a large, shallow pan of water to prevent the ants from escaping. Then, put a small paper receptacle in the tumbler. This is where the ants will place their refuse, for, you remember, they are very clean. Feed the ants with a few grains of sugar, crumbs, and bits of cracked grain.

It is best to study them under a red light after removing the black covering, because ants are not sensitive to this light. With a magnifying glass, you can spend many interesting and instructive hours watching them work.

The Relation of Ants to Man. Ants do much good, and some harm. Their burrowings into the earth give the underlying soil the air it needs. Some species destroy millions of harmful insects, and some flowers are fertilized by them. Their chief harm is done to corn. The ants raise aphid eggs, and in the spring they carry the young lice to the corn fields, so that the aphids can suck the plants and eventually yield honeydew. Ants also are unwelcome visitors to the kitchen. Termites (often called *white ants*), which are so destructive to wooden buildings, are not ants; they are different in structure but similar in social organization.

Despite any harm ants may do, no one can doubt their intelligence. Scientists have found it hard to deny the little animals the gift of reason, and, if the size of the brain is any indication, the ant's would

certainly deserve distinction, for it is larger and heavier, in proportion to the whole body, than that of any other living creature. Charles Darwin, the great naturalist, described the brain of the ant as the most wonderful atom in the universe, and many who have studied the lives of these insects echo his opinion.

Consult the following titles for additional information:

Aphids

Larva

Insects

Termites

ANTARCTIC, *ant ahrk'tik*, CIRCLE.

This is an imaginary line parallel with the equator, and $23\frac{1}{2}$ degrees from the South Pole. It is drawn on maps at $66^{\circ} 30'$ south latitude. It marks the area about the South Pole in which there is no darkness when the sun is over the Tropic of Capricorn. Darkness covers this area when the sun reaches the Tropic of Cancer. See ANTARCTICA.

ANTARCTICA, *ant ahrk'tik ah*. Even though great ice caps disappeared from the habitable lands of the world nearly a million years ago, there is still one continent held in the grip of this ancient Ice Age. This is the Antarctic, which Admiral Byrd, Lincoln Ellsworth, Roald Amundsen, and other explorers found to be the most dangerous and most difficult to approach, of all the remote places visited by them in their venturesome journeys.

The name Antarctica belongs to the bleak continental mass about the South Pole of the earth. Surrounding this barren land of ice and snow is a continuous belt of water—the Antarctic Ocean. The continental mass extends northward to about 60 degrees south latitude, and some projections even reach a latitude of 50 degrees. The entire area has been estimated to be over 5,000,000 square miles. The Antarctic Ocean is usually considered the southern continuation of the Atlantic, Pacific, and Indian oceans. There is an expanse of open ocean between the Antarctic land mass and the southern extremities of the old continents, varying in width from 600 to 2,400 miles.



United States Coast Guard

HUGE ICE SHELVES BLANKET THE COASTAL WATERS OF ANTARCTICA

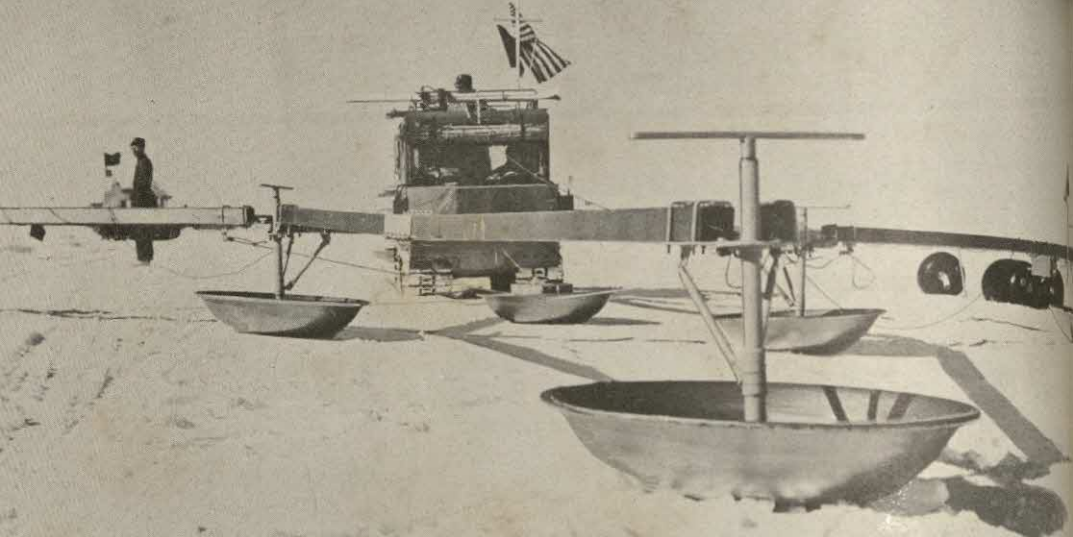
Continuous layers of snow and glacial ice have formed barriers around Antarctic coasts. This icebreaker is preparing to moor beside the Ross Ice Shelf, the largest of the ice masses.

The region about the South Pole, with its desolate plateaus and towering white mountains, its gigantic ice barrier reaching out into the sea, and its few hardy animals, is the coldest in the world. Temperatures lower than 70 degrees below Fahrenheit have been recorded in the Antarctic winter, and no month of the year has an average temperature reaching 32 degrees, the freezing point of water. In contrast to this region of bitter cold is the Arctic area, where, during one summer month, the average temperature is always above the freezing point.

In the Antarctic land there is not enough open water to temper the west winds that eternally sweep across the

frozen wastes. There is a summer in the Antarctic; it takes place when the Northern Hemisphere is having its winter, but it is very short and cold, and there is no season for plant growth as in the Arctic region. The difference between the two areas also is shown by the fact that nearly a million people live the year around within the Arctic Circle, while not a single person is known to live permanently within the Antarctic Circle. The only things that do live in this region are the delightful penguins, the seals, gulls, and a variety of under-water life. A very few tiny, blossoming plants have been found.

Admiral Byrd, in his historic flight over the South Pole in 1929, studied the huge



"DISHPANS" PROBE ANTARCTIC ICE SHEET

Hidden crevasses in the perpetual Antarctic ice are detected with dishpan-like electronic devices on a Navy weasel called a "trail blazer." It is used in uncharted areas.

UPI

mountain range that extends about 1,500 miles across the Antarctic continent, and found peaks over 10,000 feet high. On his expedition in that year, and the one in 1933-34, he also found some coal deposits.

One of the great wonders of the Antarctic region is the mammoth ice barrier extending out into the Antarctic Ocean for hundreds of miles. This great barrier, rising 200 to 300 feet high, is flat on top, and in the summer, huge pieces of it break off. These ice cakes, floating northward into the Pacific and Atlantic oceans, finally melt when they reach warmer climates. Antarctic icebergs are different from the Arctic floating masses of ice in that they are flat on top, while the Arctic bergs are peaked and rugged.

The Antarctic region was the last of the earth areas to be discovered and explored by man, probably because it is the most isolated body of land and sea in the world. In the sixteenth and seventeenth centuries, sailors would return from voyages in the southern seas with tales of boats being blown into cold and snowy waters, but it was not until late in the eighteenth century that any discoveries took place.

The first passage across the Antarctic Circle was made on January 17, 1773, by

Captain James Cook, famous English explorer. He found several uninhabited and barren islands. In 1839 Captain J. Clark Ross, another Englishman, discovered mountains on several icy islands and was the first to see the great ice barrier which was named after him. Forty years later, other explorers found evidences of a continent, and studied the plant life of the ocean.

Road Amundsen, the great Norwegian explorer, was the first man to attain that long-sought goal, the South Pole. He arrived at the Pole on December 14, 1911, locating it on a wide plateau of ice 10,000 feet above sea level. Amundsen was closely followed by Robert F. Scott, who reached the Pole a month later, on January 18, 1912. Scott and his small party died during a terrific blizzard on their return to their ship.

Admiral Byrd went to the Antarctic in 1929, and found an unexplored land which he named Little America. In 1933 and 1934, he and his men lived on the continent, spending the winter in strong, well-built houses which were buried under many feet of snow. George H. Wilkins and Lincoln Ellsworth were other explorers who conducted expeditions there.

Scientists regard Antarctica as a fine laboratory for studying the movements of ice, weather phenomena, and geological history. The whaling industry is important and has inspired several exploring expeditions. Deposits of coal and other minerals are known to lie beneath the continent. In 1939 and 1946-1947 the United States government sponsored expeditions under Admiral Byrd, in the interest of further study of the mineral resources of Antarctica and to survey the land claimed by the United States. Developing the minerals is a part of the government's program. See ARCTIC OCEAN AND LAND; BYRD, RICHARD EVELYN.

ANTEATER. This name is applied to several animals that feed entirely on ants, but it is most correctly given to certain toothless mammals of the American continents south of Mexico. They have long heads and jaws, small eyes, and short, round ears. Their tongues are long and sticky, and well adapted for lapping up the insects upon which the anteaters feed. Their legs are very strong, the rear ones being especially powerful, and the feet have long, sharp nails which are used for breaking into ant hills.

One of the largest anteaters is the antbear. It grows from four to five feet from the tip of the long snout to the base of the

bushy tail. It is a harmless, rather timid creature, and prefers its own company. The antbear loves to sleep, and when not eating, it curls up for a nap. See AARDVARK; ARMADILLO; ECHIDNA.

ANTELOPE. Fastest and most graceful of all animals is the antelope. Like the deer which it resembles, the antelope is shy and timid, and will run with great swiftness at the slightest sound or motion. There are many types of antelope, some being only a foot high, while others grow to the height of a horse. Plains, forests, mountains, and deserts are homes of these fleet animals. Most of them live in Africa, and a few occur in Asia. There are no true antelope in the Americas. These animals are continually growing less numerous because of hunters.

The antelope differs from the deer in that its horns remain the year round, while on the deer they are shed every year. Female antelope also wear horns, while female deer do not have any. The hides of the larger antelope make fine leather for shoes, luggage, and other leather goods, and the meat of all is considered a delicacy.

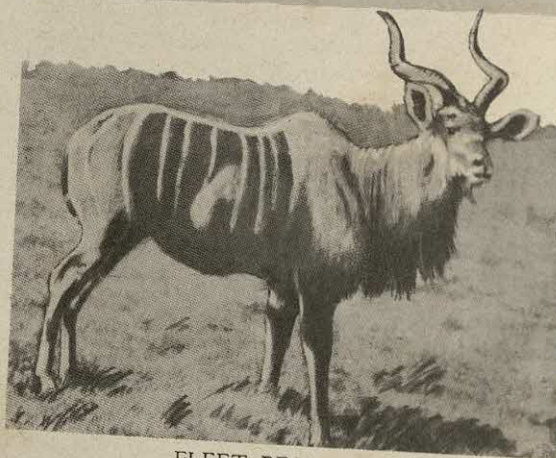
The *bushbuck* of South Africa is the smallest and most beautiful antelope. Around its neck is a white band that looks

DESIGNED BY NATURE FOR AN UNUSUAL DIET

A baby anteater rides piggy-back as its mother searches for food. The anteater tears anthills apart with its sharp claws, then licks up the ants with a wormlike tongue.

New York Zoological Society





FLEET BEAUTIES!

The koodoo (above) is one of the largest species, having long, twisted horns. The antelope-like pronghorn (upper right) roams the Western plains of the United States. The *harnessed antelope* (lower right) is so-named because of its harness-like stripes.



like a harness, and it has spirally twisted horns. The *steinbok*, another small antelope, found on the plains of South and East Africa, is noted for the quickness of its movements. It is reddish in color, and its horns are short and ringed. Still another tiny antelope of South Africa is the foot-high *guevi*, or *bluebuck*.

The African *koodoo* is one of the largest of the antelope family, and has long, twisted horns and stripes on the sides of its body. Another large type is the *eland* of Southern and Eastern Africa. Other antelope are the *saiga* of the southern part of Russia; the *sable* antelope of South Africa, which is shiny black; and the white *oryx*, which also lives in Africa and is noted for its large, sharp, backward-curving horns. See CHAMOIS; GAZELLE; PRONGHORN.

ANTHROPOLOGY, *an thro pol' o ji*.

One of the most important sciences in the world, anthropology is the study of mankind, and receives its name from the Greek, *anthropos*, meaning *man*, and *logia*, meaning *science*. The men who devote their lives to this science study man as he is today, his manner of life in the

past, and all his ways of doing things. Because nothing is more wonderful than man, anthropology is a fascinating and absorbing subject.

Anthropology covers a vast field, and attempts to tell a story that has its beginnings thousands of years ago. It is a new science, for until comparatively recent years, men had little or no material in hand on which to base a study of the age of man. The ancient Greeks, and others after them, knew that they themselves lived a certain way, and that other people, including their own ancestors, lived and spoke differently; that some people had different colored skins and hair. But they did not know the causes of these things, and their known world was small.

The modern anthropologist is able to find out a good deal more about the group life of man, past and present, because he can draw upon facts uncovered in the modern age of organized, scientific exploration and comparison. Anthropology is not concerned just with history, and



MANKIND'S THREE MAIN DIVISIONS

Asia is the dwelling place of the Mongoloids (upper left), a yellow-skinned people with round heads, flat faces, slant eyes, and gleaming black hair. The Negroid group (lower left) includes members of the tribes of Central and Western Africa. Their skin is dark or black, and they have woolly hair and broad noses. The common but incorrect name for the white race, native to Europe, is Caucasoid (right), a people with light skins, thin noses, prominent foreheads, and fine, wavy or straight hair.

the life of people in modern times. It takes in the study of original languages and religions, primitive methods of building houses and getting food, the way man's body works, how man compares with animals. It is a study of history, geography, geology, and a host of other sciences, all bound up in one. There is much that we have to learn before man's story is complete.

In our modern world we can see very easily the differences between people. Some, like the tall Scandinavians, have blond hair, blue eyes, and fair skin. Others, like the Negroes, have brown skins, black eyes, and black hair. The Japanese and Chinese are yellow-skinned. These and other characteristics are passed on from parents to children. Some people have heads that are oval-shaped; other heads are round, and others are more or

less flattened. But, regardless of the differences, we know that all people have many things in common. We all have hearts that beat, stomachs that receive food, limbs that move. Though men and women may be different in many respects, they all are similar in body structure.

Why, then, are there differences? The answer to this is anthropology's story. It begins about 500,000 years ago, when huge glaciers covered thousands of square miles of the earth, and when mastodons, mammoths, and saber-tooth tigers roamed the forests and plains. In this dark and distant past, man was governed by the same forces as animals. He roamed up and down the world, trying to find a place to live where the weather was satisfactory, where food and shelter could be had, and where he might live in safety. There was probably a land bridge between America



Wide World Photos

LOW-BROW ANCESTOR

The "earliest known man" must have been very hard-headed. Left, his 600,000-year-old skull, found in the Olduvai Gorge in Africa, is measured for size. Right, not a "wanted" poster but an artist's drawing of what the old flathead would look like with some flesh on his bones.

and Asia, which he crossed and re-crossed in his wanderings. Climate governed his life.

But man had a more receptive brain than the other animals; he learned to make fire, and implements of stone, bone, and wood. He began to worship things he could not see or understand. He learned to sail the seas. As the years went on, man settled in different places, and began to conquer the conditions around him. Climate had less effect on his choice of an abode because he had learned how to protect and feed himself. Those who lived in the hot lands developed darker skins, while those who dwelt in the cooler climates had light skins. Those characteristics of man which proved most successful, and helped him most in living, survived, and were passed on through his descendants. In different climatic regions there developed groups of people of fairly definite characteristics. Thus arose the separate races of mankind.

At the same time that the physical characteristics of man changed, he was also learning to talk and use tools. He was inventing things. Some peoples developed their language and inventions to a certain point and found them entirely satisfactory for the place and the life they were living, then stopped improving. Today, such of

these peoples as survive are known throughout the world as "primitives." Included in the class of modern primitives are certain of the African Negroes, Australian Bushmen, the Polynesians of the South Sea Islands, the Eskimos and Lapps of the North, Congo Pygmies, the Ainos of Japan, Amazonian Indians, the Andamanese of South Asia, and the natives of Tierra del Fuego.

But, though these people are primitive, it is well worth noting that their languages, if studied, can be understood by other men. These people are different from civilized groups not only in color and customs; while their progress was arrested, other people improved language and inventions. They were able in time to communicate and spread their knowledge.

As civilization grew, climate and country, which had been the most important force in the beginning, exerted less and less influence on human development. Yet the diverse characteristics of the separate races of men still remained. How much less important environment is today is illustrated in the case of Japan. Though this island country was long behind the Western world in modern modes of life and thought, within a single generation the Japanese discarded many traditional

Strange Superstitions

TO UNDERSTAND MAN — ancient and modern, primitive and civilized — the anthropologist must understand his beliefs and superstitions, for these ideas usually determine his way of life.



Lukens Steel Co.

THE AFRICAN WITCH DOCTOR and his patients believe that evil spirits cause illness, and the witch doctor wears a hideous mask to frighten them away.

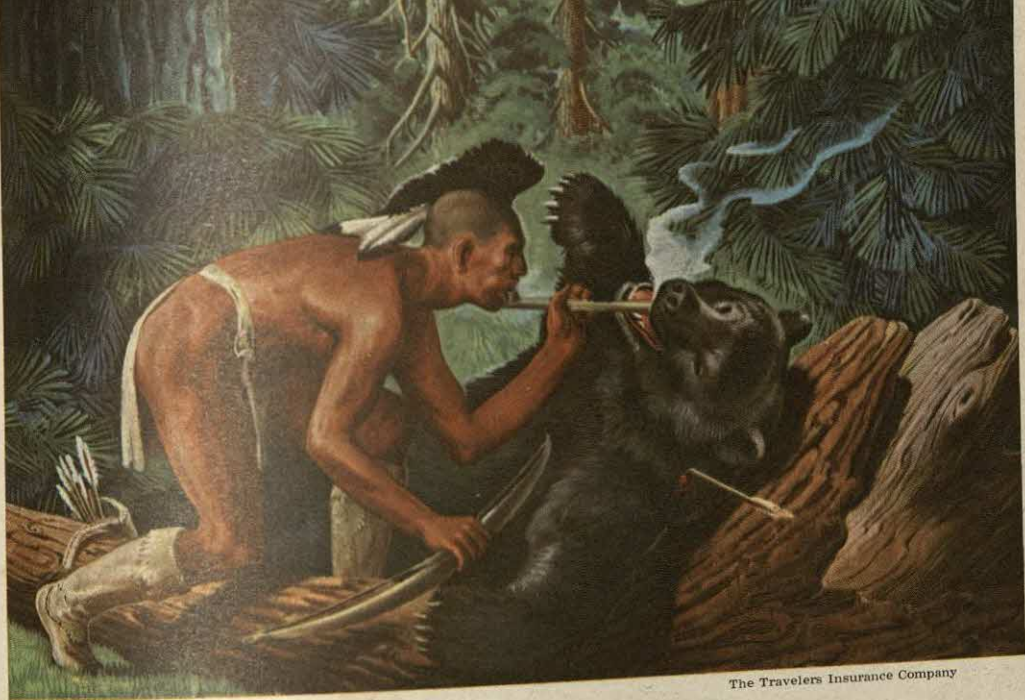


The Travelers Insurance Company

AT FUNERAL CEREMONIES in old Siam, the King threw limes to his subjects. Some of the limes contained rich prizes; others, nothing. Thus fate, or luck, ruled men's fortunes.



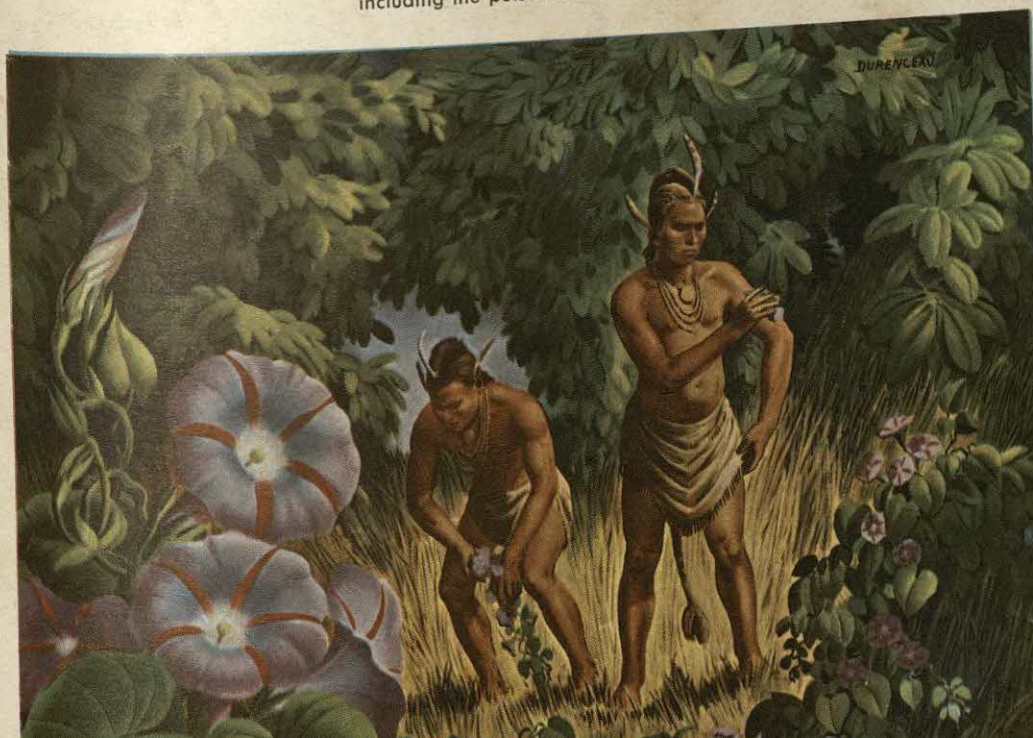
TRIBESMEN in Cambodia drove their elephants over statues representing misfortune and thus destroyed their bad luck.



The Travelers Insurance Company

THE AMERICAN INDIAN above is blowing smoke into the mouth of a bear he has killed. By "making peace" with the bear, he hoped to prevent its spirit from spoiling his future hunting expeditions.

JUICE OF THE BINDWEED is being used by the Indians below to paint their bodies. They believed that this purple coloring would keep them safe from the bites of snakes, including the poisonous rattler.





THE SPANIARDS at left are terrified by the wall paintings in an Indian dwelling. The paintings represented tribal gods and were used to ward off misfortune. The Eskimos below are driving evil spirits into a bonfire in order to begin a new year free of all bad luck.

The Travelers Insurance Company



customs and habits, and in large areas of experience they became as modern as the white nations.

Throughout the long struggle of man, brain power, not strength, has been responsible for his survival. Anthropologists have found that, in the early days, man did not have enough sheer strength to best the animals or the climate around him. Man could no more conquer a gorilla bare-handed then, or live without clothes and shelter in a fierce blizzard, than he can now. But he learned how to use a club and throw stones at animals to kill them, and he found out how to build a fire. It was the use of his mind that permitted him to rise above the level of the other animals.

Today it is possible to explain some of the most important factors in man's history, and to understand a little why the races differ from each other. It becomes clearer why some peoples live as they did hundreds of years ago, while others dwell in apartments, listen to radio, and go to moving pictures.

There are many blank pages in the story. They must be filled in by continued study. Anthropology still offers a vast field for exploration and scientific adventure.

The articles listed below provide interesting supplementary reading:

Age of Man	Geology
Archaeology	Iron Age
Bronze Age	Man
Ethnology	Races of Men
Folklore	Stone Age

ANTIETAM, *an te'tam*, BATTLE OF. The battle fought by the Union and Confederate armies at Antietam Creek, in the second year of the Civil War, marked the first serious threat to the city of Washington. Encouraged by the series of defeats suffered by the Union forces under McClellan, General Robert E. Lee invaded Maryland to a point fifty miles northwest of Washington. It was a crucial battle for both sides. McClellan had some 70,000 soldiers available, and was opposed by 40,000 under Lee. The fighting lasted but one day, September 17, 1862. In the day's

fight more men were killed than on any other single day of the war.

The result was a draw, but the Union forces won a moral victory, in that Lee had to retreat and thus failed in his plan to end the war by capturing Washington. President Lincoln's Emancipation Proclamation was issued on January first following the battle. See EMANCIPATION PROCLAMATION.

AN'TI-FEDERALISTS. Two political parties resulted from the debate over the adoption of the Constitution of the United States. The Anti-Federalists, as their name implies, were opposed to the Constitution because they feared it would give the Federal government too much power over the states. Their opponents were called Federalists. In 1800 Thomas Jefferson, the first Anti-Federalist President, defeated John Adams, who had run for re-election as a Federalist. The Federalists had become very unpopular by this time, and their party, in its original form, passed out of existence. The Anti-Federalists were called, in turn, Republicans, Democratic-Republicans, and Democrats. The present Democratic party is the direct descendant of the Anti-Federalist party.

AN'TIMONY. Bells ring more clearly, tin is whiter and harder, type is firmer and smoother, because of a bluish-white or silver-white metal called antimony. This metal readily unites with other metals to form alloys, making the resulting metals harder. Antimony also has the property of expanding on cooling. Britannia metal, pewter, and type metal are all important alloys containing antimony. The metal is also used in the manufacture of explosives, paints, and battery plates. Combined with hydrogen, it forms stibine, a poisonous gas; and one of its compounds with oxygen is the active base of tartar emetic, a medicine.

Antimony sometimes occurs as a free metal, but is obtained chiefly from the ore stibnite, a compound of antimony and sulphur. The principal commercial deposits are in China. In separating the metal, the

ore is melted with iron, which combines with the sulphur. Antimony itself melts at a lower temperature than steel, or about 630°C.

ANTIOCH, *an'te ok*. Twenty miles from the Mediterranean, in the lovely valley of the Orontes, in Turkey, is the unimportant town of Antakiyeh, with a population of about 30,000. Ruins of ancient walls and aqueducts are the only reminders of a splendid city that occupied the site many centuries ago. Antioch, called "the Queen of the East," was founded by the Syrian king Seleucus Nicator, 300 years before Christ. It was named for his father Antiochus and became the seat of government of his successors.

In 64 B. C. Antioch passed to the Romans. It was used as an Eastern capital by Julius Caesar and other emperors, and acquired a splendor rivaling that of Rome. At the height of its prosperity it had a population of 400,000.

As a center of Christian thought and influence, Antioch has an important place in New Testament story. Here, in the early days of the faith, the disciples of Christ were first called Christians. From Antioch Paul made his first missionary journeys. The prestige of the city began to wane in the third century A. D., and it thereafter suffered from successive visitations of earthquakes and invading armies—Persians, Saracens, Crusaders, Egyptians. Old Antioch was completely destroyed in 538. American missionaries maintain a school in the modern town of Antakya, the capital of Hatay province, Turkey.

ANTISEPTIC, *an ti sep'tik*. This name is given to any chemical that prevents or checks the growth of the tiny organisms (bacteria) which cause *sepsis*, or blood poisoning. At one time scientists believed that decay and infection were caused by organisms that developed spontaneously from lifeless matter. The great Frenchman, Louis Pasteur, proved that every kind of fermentation is due to a special organism, and because of his discovery it has been possible to reduce disease and

prevent death for both man and animals.

Among the common drugs used as antiseptics are alcohol, iodine, and formaldehyde. Intense heat and intense cold kill or check bacteria, and for this reason we sterilize food by cooking it or preserve food products by packing them in ice. See BACTERIA AND BACTERIOLOGY.

ANTITOXIN, *an ti tok'sin*. Bacteria that enter the body through cuts and wounds may form poisonous substances called toxins. The blood of the infected person attempts to neutralize a toxin by forming anti-bodies called antitoxins. Death may occur when the patient is not able to form enough antitoxin to neutralize the bacterial toxins. Antitoxins are now prepared in laboratories, and when given to patients suffering from certain diseases, these preparations often bring about cures. See SERUM THERAPY; BACTERIA AND BACTERIOLOGY.

AN'TONY, MARK (83-30 B. C.). During the period when Julius Caesar was the greatest Roman statesman, Mark Antony was prominent in the political affairs of the republic. His career had so much of interest that Shakespeare made him the hero of his play, *Antony and Cleopatra*. Antony was a younger relative of Julius Caesar, and served under his famous kinsman in the conquest of Gaul. Later, when Caesar and Pompey became rivals, Antony aided the former, and took part in the Battle of Pharsalia, where Pompey was defeated.

It was Mark Antony who turned the people against Caesar's murderers, in the eloquent funeral speech that is the most famous passage of Shakespeare's *Julius Caesar*. While Antony may not have uttered the actual words written by the poet, we know that the oration had the spirit of this passage, for the conspirators fled from the city in terror of their lives. This was in 44 B. C., when Antony was consul.

In his will, Caesar left his estate to his nephew Octavianus, who later became the first Roman emperor, under the name Au-



New Mexico Tourist Bureau

APACHE DEVIL DANCE

Armed to fight "spirits," the Apache perform a ceremonial dance. The Apaches were a fierce, warlike people, and are highly independent to this day.

gustus. Antony, Lepidus, and Octavianus formed a *Triumvirate* (union of three) and divided the Roman world among them. Antony received Gaul; Lepidus, Spain; and Octavianus took Africa and Sicily.

In 42 B. C. Antony and Octavianus defeated Brutus and Cassius, the murderers of Caesar, at Philippi, and Antony then proceeded to Asia, where he met the beautiful Cleopatra, queen of Egypt. Falling under her influence, he followed her to Alexandria. Meanwhile trouble had developed in Italy between his relatives and Octavianus, and he was recalled to Rome, but the matter was settled before he reached there. A new division of the Roman world was now made, by which Antony obtained the East.

Sometime later, war was declared by Octavianus, apparently against Cleopatra, but really against Antony. At the Battle of Actium Antony was defeated. He returned to Alexandria and, deceived by a false report of Cleopatra's death, killed himself by falling on his sword. See CAESAR, CAIUS JULIUS.

APACHE, a *pach'e*. This fierce, warlike tribe of Indians inhabited Arizona, New Mexico, and the northern states of Mexico in colonial times. Living originally in the vicinity of the Great Slave Lake in Canada, they had come down from the north ages before. For years they harassed and terrified the white settlers who crossed the continent to settle in the Southwest.

Their leader, Geronimo, was captured by General Miles in 1886, and, with other



APOLLO, MOST BEAUTIFUL OF THE GODS

Second to Zeus in importance, Apollo was the Greek god of light, song, poetry, and medicine. He was later adopted by the Romans as one of their gods.

hostile Indians, was afterward kept as a prisoner at Fort Sill, Okla.

The well-educated Antonio Apache was one of the officials of the department of anthropology at the World's Fair in Chicago, in 1893. About 6,000 Apaches live in Arizona, and over 1,300 in New Mexico. See INDIANS, AMERICAN.

APE. This name is applied to large monkeys of the Old World. Some apes are called *anthropoid*. They resemble men in form and in number of the teeth, but when walking bend forward and assist themselves with the knuckles of the hands of their long forearms. Their hind limbs are short, and their feet, if we can call them feet, are nearly as capable of handling objects as are the hands of the forelimbs. Ability to use their feet enables most apes to climb about trees quickly and easily.

Apes are found wild only in the tropical regions of the Old World. They include well-known forms like the chimpanzees, the orang-utans, and the gorillas. Chimpanzees and orang-utans are easily tamed and intelligent, but gorillas are not to be trusted. Chimpanzees stand about five feet tall and live a great deal upon the

ground. Orang-utans are shorter and in the wild state spend most of their time in trees. Gorillas are much larger than either of these. The food of apes is largely fruits of various palm trees, nuts and other vegetable matter, eggs and honey, though at times they will also eat flesh.

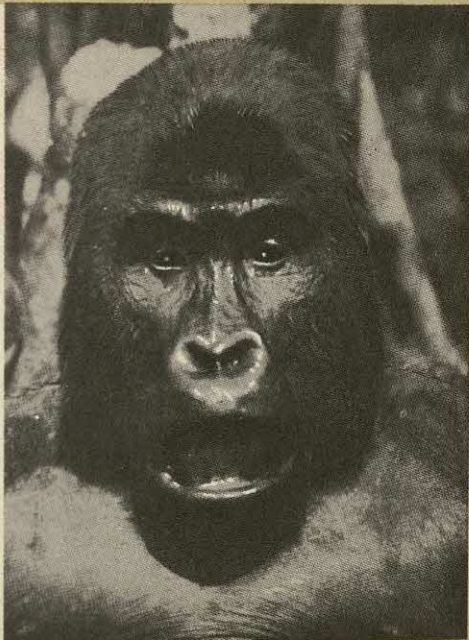
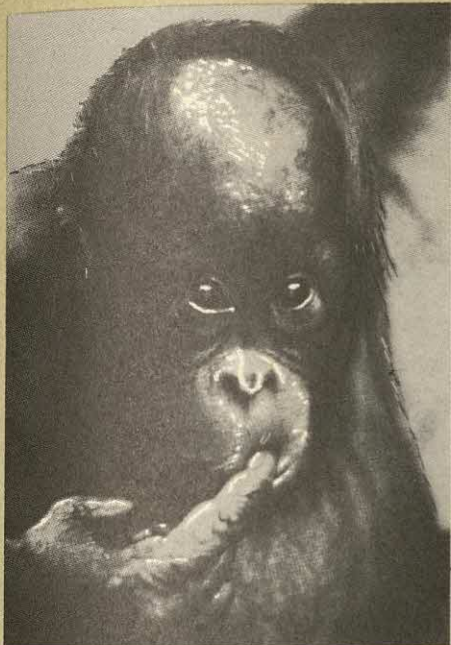
The interesting habits of apes and monkeys are told about in these volumes in the following articles:

Baboon	Gorilla
Chimpanzee	Monkey
Gibbon	Orang-utan

APHIDS, *afidz*, or APHIDES, *afi deez*. Also known as plant lice, these small greenish bugs live on the tender young leaves, twigs, or roots of plants, sucking the sap through long, sharp beaks. Some of them have two tiny tubes on their backs, through which they expel a sweet liquid called honeydew, that ants and other insects like. Ants sometimes collect and care for the plant lice, in order to have a supply of the fluid. See ANT.

Aphids are injurious to fruit, vegetables, and shade trees, and often become great pests. They themselves are preyed on by birds, spiders, ants, and ladybird beetles. In fact, if it were not for the many insect and animal enemies of the aphid, as well as the effect of weather conditions and artificial control, these small, soft-bodied insects would be a serious problem. For they come to maturity quickly, and reproduce very rapidly.

APOLLO. In ancient Greek and Roman mythology, Apollo was the god of poetry, song, and medicine, and the patron of music. Also identified with Helios, god of the sun, he was thought of as driving a fiery chariot across the heavens, giving the earth the light of day.



HAIRY CITIZENS OF THE JUNGLE

Apes belong to the highest order of animals. The two in the lower picture are chimpanzees, which are quick to imitate the ways of man. They can learn to walk upright, use simple tools, and even to wear clothes. They are used in many scientific experiments. The orang-utan (upper left) still prefers the jungle to the laboratory. And the gorilla (upper right), biggest of apes, is a savage wild beast.

Apollo was the son of Jupiter and Leto, and twin brother of Diana. On the fifth day after his birth, he killed the serpent Python, and afterward, with Diana, he killed the twelve children of Niobe, who unwisely boasted of them to Leto. He also destroyed the Cyclopes, because they forged the thunderbolts with which Jupiter killed Aesculapius, Apollo's son.

Among the ancient statues of Apollo that have been preserved, the most remarkable is the one called the *Apollo Belvedere*, from the Belvedere Gallery in the Vatican at Rome. SEE SCULPTURE.

APOSTLES, a *pos'l'z*. This name has a special meaning when applied to the twelve chosen disciples of Jesus Christ. It is also used in the Bible in a more general way to refer to such divinely appointed missionaries as Paul and Barnabas. Later, Saint Boniface was called "the Apostle of Germany" and Saint Augustine "the Apostle of England." The name is from the Greek word meaning *one sent forth as delegate*. In *Hebrews* III, 1, Christ is spoken of as "the Apostle and High Priest of our confession."

The twelve apostles of Christ were Simon Peter and Andrew, brothers; James and John, the sons of Zebedee; Philip; Bartholomew; Thomas, the Doubter; Matthew, author of the Gospel according to Saint Matthew; James, the son of Alphaeus; Thaddeus, or Judas, who was "not Iscariot"; Simon the Canaanite, and Judas Iscariot. After the betrayal, Matthias was chosen by lot to take the place of Judas Iscariot. SEE BIBLE.

APOSTOLIC SUCCESSION. In the Roman and Greek Catholic and the Anglican Churches, bishops are believed to be the spiritual successors of the early Christian apostles. These Churches therefore refuse to recognize the ordination of priests and ministers unless these officers have been consecrated by those in direct apostolic succession. The doctrine implies that every consecrated bishop is a successor of one who preceded him, and that the line began with the apostles. SEE BISHOP.

APOTHECARIES', a *poth'e ka riz*, **WEIGHT**. In dispensing drugs, the system employed in weighing ordinary commodities (16 ounces to the pound) is not used. Instead, apothecaries' weight is employed. In this system the pound is divided into 12 ounces, the ounce into 8 drams, the dram into 3 scruples, and the scruple into 20 grains. The apothecaries' grain, however, is equal to the grain used in our more familiar avoirdupois system; it is also the same in Troy weight, used in weighing gold, silver, and jewelry.

APPALA'CHIAN MOUNTAINS.

Two hundred years ago, this rugged chain of mountains was a barrier which held the American colonists to the Atlantic coast and so helped to unify them. Extending more than 1,300 miles southwest from the Gulf of Saint Lawrence to Central Alabama, the range fenced off the empire of the Indians, French, and Spanish from the ports and plantations of the English.

In the north, the valleys of the Mohawk and the Hudson, routes to the great Mississippi basin, were blocked by the French; in the south, Spaniards stood across the path to the west. The only other road to the rich, fertile lands in the interior lay over the mountains or through a few wild gaps cut by rivers. Indians lurked on the forest-covered slopes, and for a century the colonists clung to their strip of coastal plain.

After the French and Indian wars ended, in 1763, the pass through the Mohawk Valley was open. Between the Blue Ridge range on the east and the Alleghenies on the west, the great Appalachian Valley, twenty-five miles wide, made a safe highway north and south. Many settlers traveled into this valley. Scotch-Irish immigrants, "Pennsylvania Dutch," and English either formed settlements in the valley or drifted into Kentucky through the Cumberland Gap. Some of them continued on to the Mississippi. At times, groups of families would break away from the main stream of pioneers and settle in the mountains, where their descendants



Pennsylvania State Department of Commerce

WANDERING WATERWAY WEARS AWAY THE APPALACHIANS

Delaware Water Gap was carved by the Delaware River through the Kittatinny Mountains in Pennsylvania. The gap is a part of the Great Appalachian Valley.

still live, little affected by the changes of subsequent years.

The Appalachians are old, geologically. Their tops are round and low, compared to the high peaks of the younger Rockies. At one time the Appalachians may have been folded up as high as the great range to the west, but thousands of years of rain, snow, wind, and ice have worn them down. When the Appalachians were formed, great swamps and forest areas were compressed in the upheaval, and in time turned into the buried deposits of coal, oil, and gas found in Pennsylvania and other Eastern states. Marble, gypsum, iron ore, and limestone are also mined in these mountains. The many streams which tumble down from the Appalachian fall line are an important source of water power for manufacturing. They helped the colonists grind their meal and saw their lumber, as today they run the great mills of Eastern industry.

The ranges which make up the Appa-

lachians have been divided into three great sections: the northern includes the Green Mountains and the White Mountains (by some geographers the Adirondacks are also included); the central includes the Blue Ridge, the Allegheny, the Cumberland, and a number of smaller ranges; the southern includes the continuation of the Blue Ridge, the Black Mountains, and the Smoky Mountains.

The Appalachian chain consists of several ranges which are in general parallel to one another. As the mountains approach the south, their altitude increases. The highest peak is Mount Mitchell in North Carolina (6,684 feet). The climate of the mountain region is temperate, the average annual temperature ranging from 46°F. in the north to 61°F. in the south. Because of this mild climate and the beautiful scenery, the mountains are a favorite summer resort.

Consult the articles in these volumes under the names of the various ranges.

APPLE. So full of juicy goodness, fresh from the tree; so delicious, encased with sugar and spice in crust of flaky brown—the apple is a treasure among fruits. From great antiquity it has been cultivated throughout the temperate lands of the world, and is today a widely grown and highly valued orchard product. The apple has a rather hard, juicy pulp, formed around a core, which contains five horny cells, each bearing two seeds. The flesh is white or slightly pinkish. Most apples are nearly round, though some varieties may be more of an oval shape. The skins are as varied in color as the leaves of autumn, with tones of red, green, and yellow.

Like many of our temperate fruits, the apple belongs to the rose family. Both its flowers and fruit are similar in structure to those of the rose. There are dozens of species of wild apples native to the temperate regions of the world. Only two are important in cultivation, the common apple and the crab apple.

The cultivated crab apple is native to Siberia. Commercially it is little grown in the United States or Canada, but is cultivated in home gardens for jellies and preserves or in sections where the climate is too cold for the common apple. Its culture is similar to that of the common apple (see **CRAB APPLE**).

An Apple for Every Taste. The common apple has been cultivated from time immemorial. It has been carried to all temperate climates of the globe, and has become our most important orchard fruit. The fruit of the apple, in its natural state, is small, sour, crabbed and scarcely better than that of the wild crab apples native to the United States. The wild trees are more or less thorny, gnarled, and with crowded branches. Under cultivation the apple has become quite variable, so that the world now has several thousand improved and named varieties, differing in character and suited to the different regions and to the different purposes for which they are grown.

The apple is one of the most cosmopoli-

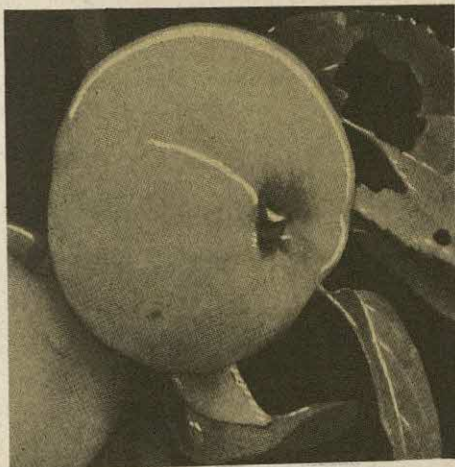
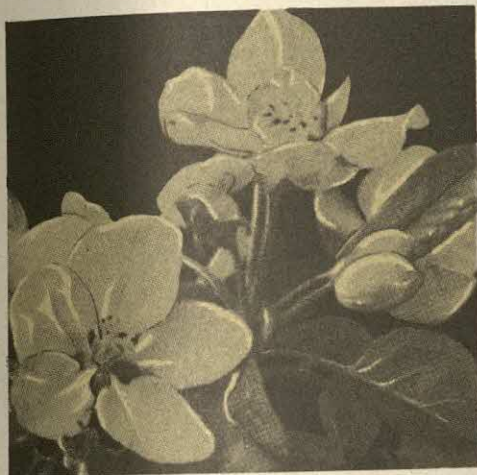
tan fruits in its adaptability to a considerable range of conditions, growing well in many kinds of soil when properly cultivated. New varieties may be produced by seed selection, but the more desirable fruits have been obtained through grafting selected slips or cions on hardy native stock. Varieties of apples differ greatly in size, color, texture, flavor, and in time of ripening. One may suit one's taste, whether it be for sweet apples or those which are tart and sour. Certain varieties ripen in early June, while some of the firmer sorts will keep, under favorable conditions of storage, until the succeeding crop is ripe.

America Leads in Apple Orchards.

Though apples are grown in all temperate regions, the United States is the leading apple-producing country in the world. Apples are grown, at least to some extent, in every state. This fruit reaches its best development, however, in the cooler temperate regions of the country. In Canada apples are grown commercially in all except the Prairie provinces. The greatest apple-producing section embraces favored parts of a belt extending from Nova Scotia westward to Lake Michigan.

Other important apple districts are the Piedmont region of Virginia and some of the highlands of adjacent states; the Ozark region, embracing portions of Northwestern Arkansas, Southern Missouri, and Southern Illinois; the plains region of the Central West; the mountain valleys from Montana and Idaho to New Mexico; the Pacific Northwest, embracing parts of British Columbia, Washington, and Oregon; and the coastal and foothill sections of California.

Appetizing Varieties. About 500 varieties of apples are now being propagated and planted in the United States and Canada. More than eight times this number have been introduced and planted from time to time. Such varieties as Baldwin, Rhode Island Greening, Tompkins King, Northern Spy, Ben Davis, and Gano comprise a large portion of the commer-



FROM GLORIOUS PROMISE TO FRUITFUL HARVEST

With each recurring spring, gay blossoms proclaim the merit of this king of fruits. cial apple crop grown in the United States.

The first four are most extensively grown in the Northern states from New England westward to Lake Michigan. The last two, together with Winesap and Jonathan, are leading sorts in the more southern belt, extending from West Virginia and Virginia westward to Arkansas and eastern Kansas. All the varieties thus far mentioned are good shippers and keep for long periods in storage; consequently, they are capable of wide distribution and they have a long period for consumption.

Sebastopol district of California is widely known for its Gravenstein apples, while the Wenatchee Valley, in Washington, is famous for its Delicious.

In commercial orchards the tendency is to restrict planting to one or two varieties which are best adapted to the neighborhood. For home use or for strictly local market, a succession of varieties, ripening from early until late, is ordinarily better. Amateurs sometimes plant dozens of varieties, enough to suit almost any individual taste and to fill the longest possible season.

Uses and Value. While the apple is a popular dessert fruit for use in a fresh state, it also lends itself to a variety of fruit products which are made largely from the lower grades of fruit. Formerly, large quantities were dried for cooking purposes. Today, evaporated apples are put up in large quantities in evaporating houses. Apples are also canned, made into jelly, apple butter, mincemeat, cider and vinegar, and are used as a foundation for other products.

Over eighty per cent of the juicy pulp is water, and apples therefore do not rank high as fuel foods. Their food value is due to the acids and sugar contained in the pulp, and to their appetizing taste and flavor. That is, apples are valuable for

Some of the more important early varieties, ripening in about the order named, are Yellow Transparent, Red June, Red Astrachan, Early Harvest, Maiden Blush, Oldenburg (Duchess of), Wealthy, and Fall Pippin. These supply the market and home table, in succession, after the winter varieties of the previous season pass their best storage period.

A given variety of apple may be very important, locally, in a district where it reaches exceptional development, and yet comprise but a small portion of the apple crop of the country. For example, the Yellow Newtown is the leading variety in the famed apple district about Watsonville, Calif. The same variety (under the name Albemarle Pippin) has long been equally important in Albemarle county, Va. The

their tonic and regulating properties, and there is truth in the familiar saying—"An apple a day keeps the doctor away."

The Burbank Apple. A seedless and coreless apple was developed by John F. Spencer and Luther Burbank. The fruit is of good size and has a delicious flavor. The tree that bears this seedless variety has no blossoms in which the codling moth can lay its eggs, and produces wormless apples. The lack of flower also eliminates danger from late frosts.

APPOMATTOX, *ap o mat' oks*, **COURT HOUSE.** On April 9, 1865, General Robert E. Lee of the Confederate army surrendered to Ulysses S. Grant of the Union army, virtually ending the Civil War. The surrender was accepted by Grant in the McLean House, a large residence near the village of Appomattox Court House, Va. The village is situated twenty-five miles east of Lynchburg and is now part of a National Historical Park established in 1940. See **CIVIL WAR**.

APRICOT, *a' pri kot*, or *ap' ri kot*, a popular garden fruit, belonging to the rose family and native to Eastern Asia. In appearance the tree and fruit are somewhat intermediate between the peach and the plum. Most varieties of apricots ripen later than the cherry, but earlier than the peach or plum, thus filling a season not fully occupied by other fruit. The apricot is of very high quality, being regarded by some as superior to the peach. The fruit resembles the peach in shape and color, but is somewhat smaller, has a smoother skin, rich, yellow flesh, and a flatter, smoother stone. Like the peach, the apricot may be canned, dried, or used as a dessert fruit in its fresh state.

The apricot tree is about the size of a peach tree; is round-headed in-form; has dark, rich-colored, somewhat peachlike bark; and large, almost circular leaves somewhat resembling those of the cottonwood. The older leaves are thick, glossy, and a rich, dark green; while the tender new leaves near the growing points assume purplish and pinkish tints. The

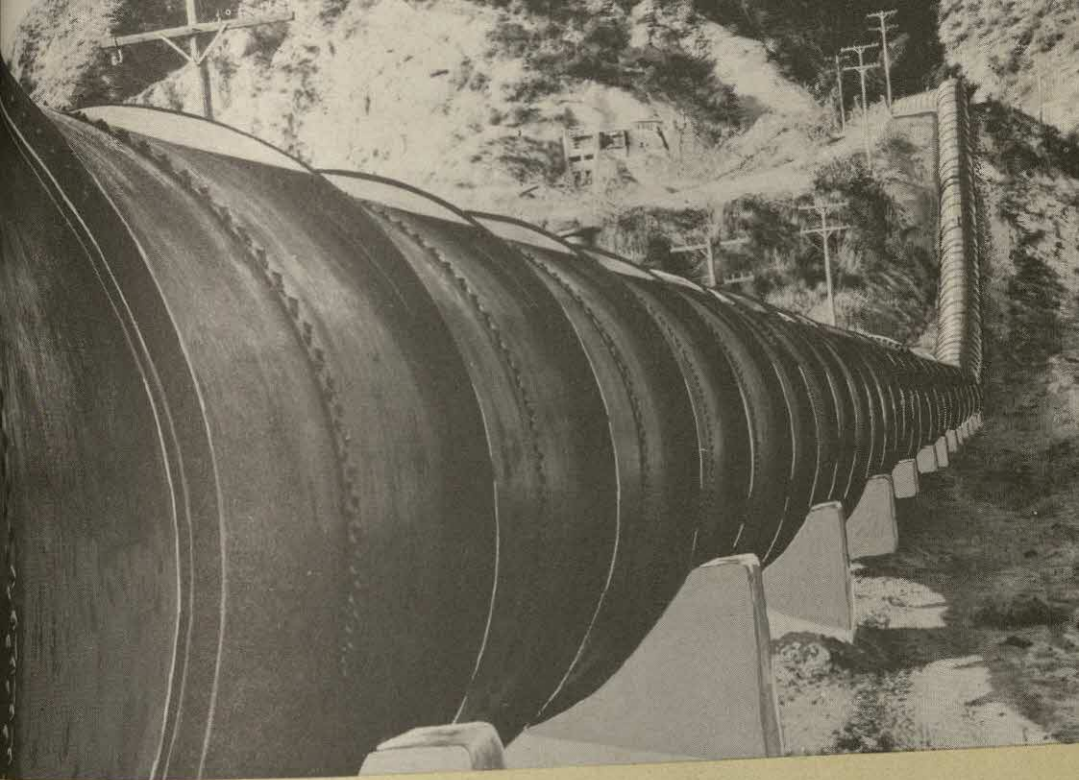
round, golden fruit with reddish blush, in its setting of rich foliage, gives the apricot tree a beauty which rivals that of the orange. The apricot tree compares in hardiness to the peach tree. It blossoms much earlier than the peach, and, consequently, its flowers and young fruit are often killed by spring frosts, except in favored locations. California and Arizona produce most of the commercial crop in America.

'APRIL. In our modern calendar, April is the fourth month of the year. *Aprilis*, as the Romans called it, was the second month of the calendar in use before Julius Caesar, and it then had twenty-nine days. In the Julian reform of the calendar, April was given an extra day, receiving its present quota of thirty days. The special flower of April is the daisy, and the diamond is the birthstone for people born in this month. Its name comes from the Latin verb meaning *to open*, suggesting that this spring month is the time of opening flowers. See **CALENDAR**.

AQUATIC, *akwat' ik*, **PLANTS.** There are a number of plants which grow wholly or partly under water. Some float freely in the water, others have their roots in the soil at the bottom. All of these plants are called aquatic.

Pond and water lilies are familiar aquatic plants that send up long, stout stems from the muddy bottoms of ponds. Their leaves or "pads" float on the water or project above it. On summer days frogs and water bugs use the large round or ovate leaves as diving platforms or barges upon which to drift in the sun. The cup-shaped flower of the lily which opens above the water may be white, red, pink, orange, purple, or lavender-blue.

Among the many other interesting aquatic plants are the bladderworts, bulrushes, cat-tails, and lotus flowers. The bladderworts have small water-filled bladders on their stems and leaves. When seed-bearing time approaches, the bladders fill with air and lift the flowers above the surface. Since these plants live in soil that



HIGHWAY FOR A PURE DRINK

The city of Los Angeles gets water through a great aqueduct, which carries it from a distant source.

has very little nitrogen, they eat insects whose bodies supply them with it. Each of the bladders has a trap door or valve which opens to admit insects searching for food. Then the door closes and the insect is caught. Its body will be absorbed by the plant. Such a plant is called *carnivorous*.

In addition to aquatic plants there are a number of plants called semi-aquatic, which live in marshes and swampy ground. Although their roots are in the soil, they may be submerged in water. Such plants are the butterwort, pitcher plant, sundew, Venus's flytrap, swamp fern, swamp grass, and swamp thistle.

AQUEDUCT, *ak' we duk't*. When a farm boy gets thirsty he goes to the well. But giving the city boy or girl a drink of cool, fresh water is hardly so simple. The water you unthinkingly turn on at the faucet may have come many long miles, over mountains, over rivers, and through tunnels big enough to carry railroad trains.

Nature's water paths are called rivers or creeks; these man-made channels are known as aqueducts.

No story of man's struggle to civilize himself is more thrilling than the quest for water. As long as people lived in wandering tribes, as hunters and shepherds, they did not need to worry about water. The American Indians had only to dip from streams and lakes and natural springs. It was when cities began to grow that trouble started. Fortunately, some cities found all the water they needed close by. Chicago pumps it from Lake Michigan. Kansas City runs part of the Missouri River through a giant filter to get pure water, and Saint Louis purifies the water of the Mississippi in the same way. Many smaller cities have big wells. But other cities, like big trees, must send out long thirsty "roots"—to streams or lakes or reservoirs sometimes hundreds of miles away.

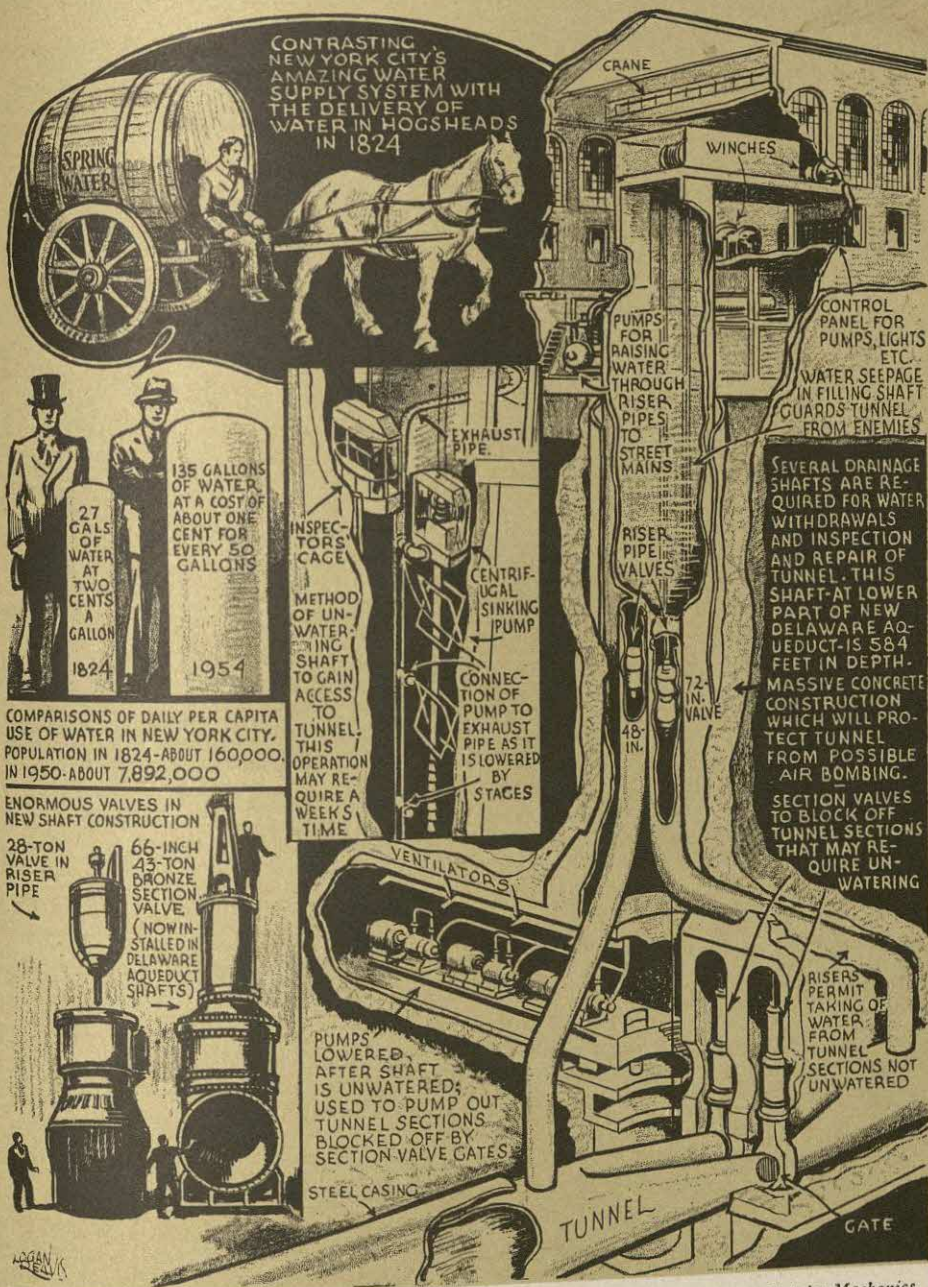
Aqueducts of the Past. Ancient Rome, conquering the world, conquered Nature,



Courtesy Popular Mechanics

COLLECTING ENOUGH WATER TO SUPPLY A GREAT CITY

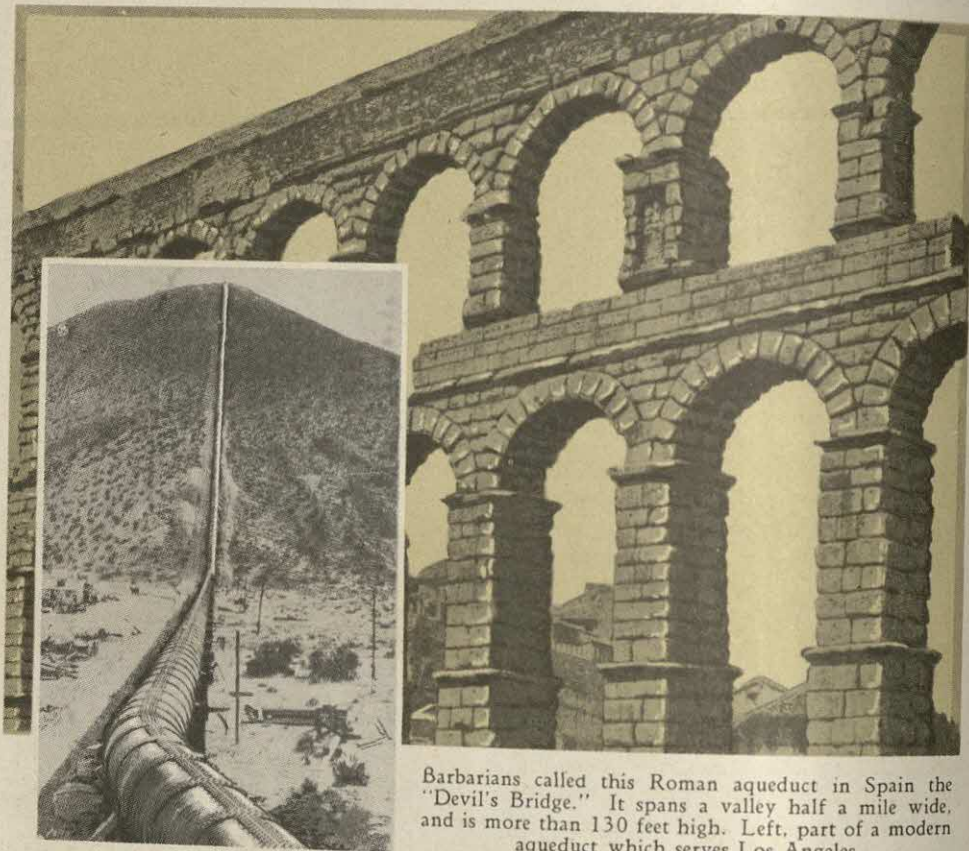
The Delaware Aqueduct and its subsidiary tunnels help to supply water to the enormous population in New York City. Although the water supply has been increased, engineers must constantly plan for ever-increasing demand.



Courtesy Popular Mechanics

MONSTER TUNNEL CARRIES A RIVER TO OUR HOMES

Millions of gallons of rushing water pounding through a tunnel for 80 miles gather tremendous speed and power. The gigantic machinery pictured here is designed for the safe control and distribution of this great flow of water.



Barbarians called this Roman aqueduct in Spain the "Devil's Bridge." It spans a valley half a mile wide, and is more than 130 feet high. Left, part of a modern aqueduct which serves Los Angeles.

too, for its engineers found a way to bring water from many miles to serve the city: not just water to drink, but water to carry away filth and refuse, to clean streets, to wash clothes, and to flow through the famous Roman public baths. The Romans built great aqueducts not only into Rome but into many of the conquered cities of Europe, leaving those cities cleaner and happier and more flourishing.

Some are still in use, so well were they built. The Pont du Gard in Southern France is nearly perfectly preserved today. The traveler who visits it can easily imagine the heroic scenes of toil as it was being built: thousands of slaves sliding great stone blocks into place, with stern-faced engineers and slave masters looking on and taking measurements.

The early Roman aqueducts were big open canals, built of stone or bricks. Be-

ginning high back in the mountains, they were tunneled through hills, trenched along valleys, and carried over rivers on arches. The Pont du Gard arches are 160 feet high—as tall as a fifteen-story building—and 882 feet long.

Another famous Roman aqueduct, at Segovia, was built by putting one row of stone arches on top of another row, to carry water 100 feet high across a valley for more than one-half mile. Its builders were in their graves over a thousand years before another aqueduct so remarkable was built. A French king, Louis XIV, seemingly to out-do the Romans, built an aqueduct forty miles long to supply the flourishing city of Marseilles.

Aqueducts of Today. Water in those old canals had to be kept level, flowing slowly and evenly along. Today, aqueducts are often built of concrete or steel

pipes. Through these pipes, as in a giant garden hose, water can be rushed up one side of a mountain and down the other. Too, modern engineers know how to tunnel deep through the ground for miles, as, for example, in building the old and new Croton aqueducts, which help keep New York's millions of faucets, drinking fountains, and fire hydrants always instantly ready to gush pure, cold water. New York soon outgrew its supply, and now it has an even bigger Catskill aqueduct system, ninety-two miles long, with more miles of branch lines that take 500,000,000 gallons of water over the city every day.

But the Romans would really blink their eyes in wonderment at the "impossible" engineering feat undertaken to permit Los Angeles, Calif., to keep on growing. The Metropolitan Aqueduct, as it is called, is one of the greatest engineering tasks ever completed by man. It carries a thundering, swirling rush of water 241 miles from the Colorado River to the edge of the city. Workmen bored and blasted their way through ninety-one miles of sixteen-foot tunnels through rock mountains. They buried the biggest concrete pipe or tube ever constructed, in the desert sands. They toiled in Sahara-like heat to build miles of open canals. All this labor has made possible a great metropolitan area and a rich agricultural section in a land that would revert to semi-desert conditions without the aqueduct, man's challenge to Nature. See IRRIGATION.

AQUINAS, a *kwi' nahs*, SAINT THOMAS (1227-1274). During the Dark Ages of civilization, learning was preserved chiefly by the members of the Catholic Church in Europe. Monks studied in their abbeys and sometimes conducted schools. One of the most celebrated of medieval teachers was Thomas Aquinas, who journeyed from place to place, conducting schools in Cologne, Germany, and in Rome, Bologna, and Pisa, Italy. His students were so fond of him, because of his kind and gentle manner, they called him "the Angelic Doctor."



Wide World

A WEE BIT O' ARABIA

Reminding us that Scottish Highlanders are not the only bagpipe players, this Arab band plays on a parade ground in Jordan.

Aquinas wrote numerous works in Latin, the most important being the *Summa Theologiae*, which became the leading book on the beliefs of the Roman Catholic Church. In 1323, nearly fifty years after his death, Aquinas was made a saint by Pope John XXII.

ARA'BIA. A land of desert wastes, scattered oases, and wandering tribes, Arabia is a huge peninsula in Southwestern Asia. In a broad sense it extends as far north as Palestine. On the other three sides are the Persian Gulf, the Arabian Sea, and the Red Sea. Although Arabia covers an area of about 1,000,000 square miles, it has a population estimated at about 12,000,000.

Central Arabia is largely a plateau, or tableland, that slopes off into deserts and steppes. Beyond is a fringe of mountains lying between the deserts and the lowlands along the coast. Like most desert countries, Arabia is hot and dry. Little rain falls anywhere, and in some places a year or more passes without rain at all. Dates are the principal food raised. In fact, the date palm is almost the only vegetation to be seen in many places. However, wheat, barley, maize, and millet are raised

also. Coffee, too, is an important product, as are myrrh, frankincense, balsam, aloes, and mastic.

Cattle graze on sweet-smelling herbs that grow for brief seasons. Gazelles, lions, panthers, hyenas, and jackals roam the country. Mineral products found in Arabia are saltpeter, mineral pitch, petroleum, salt, and sulphur, as well as such precious stones as the carnelian, the agate, and the onyx.

Although today Arabia is not of great importance among nations, we must not

forget that, in ancient days, the Arabians developed a high civilization; made important contributions to religion, chemistry, astronomy, mathematics, and geography; and ruled a large area on both sides of the Mediterranean Sea. We know little of the very early history of the country. We do know, however, that several hundred years before the time of Mohammed, the prophet of Allah, many Jews took refuge in Arabia when Jerusalem was destroyed by the Romans in A. D. 70. Christians, too, moved into Arabia and taught the people to worship only one God instead of many idols.

Although the Arabs had never before been united, after the coming of Mohammed they banded together and spread their faith as they conquered Persia, Syria, Egypt, and North Africa. They even set up a kingdom in Spain, where they were known as Moors. The power of Arabia lasted until 1258, when Baghdad fell. Then, in the fifteenth century, Ferdinand and Isabella expelled the Moors from Spain. Not long after, Turkey conquered a part of Arabia. However, during the first World War, the Arabs, with British aid, rebelled and freed themselves from the Turks.



TASTY DATE PASTRIES START IN ARABIA

An Arab climbs a palm tree to gather baskets of dates. His family may eat the fresh fruit or it may be dried, sold, and exported to be used in kitchens around the world.

Standard Oil Co. (N.J.)

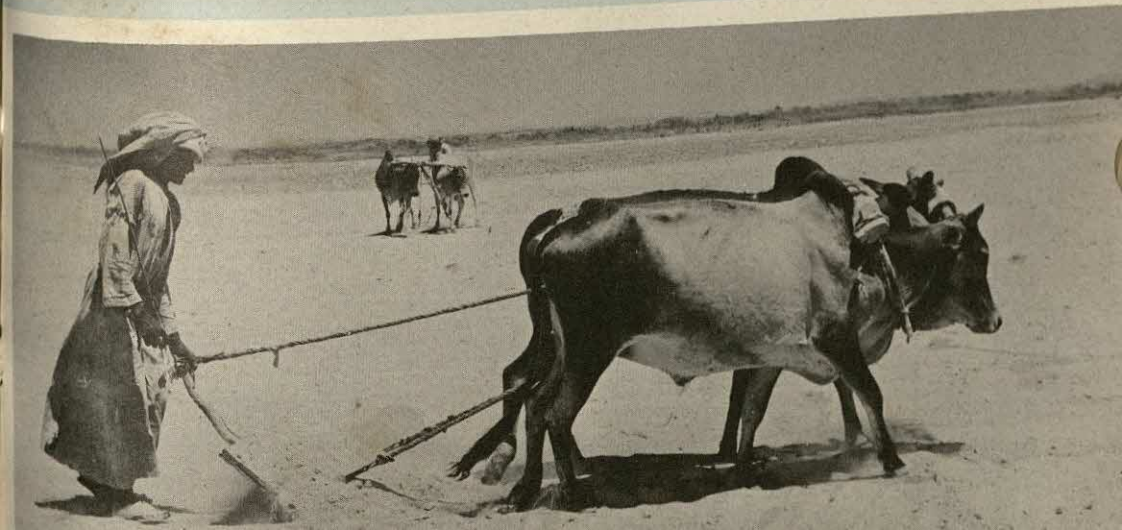




Above, from one of a series of oil paintings, "A History of Pharmacy in Pictures," commissioned by and copyrighted by Parke, Davis & Co.; reproduced by special permission. George A. Bender, project director; Robert A. Thom, artist.

ARABIA, BIRTHPLACE OF A GREAT CIVILIZATION

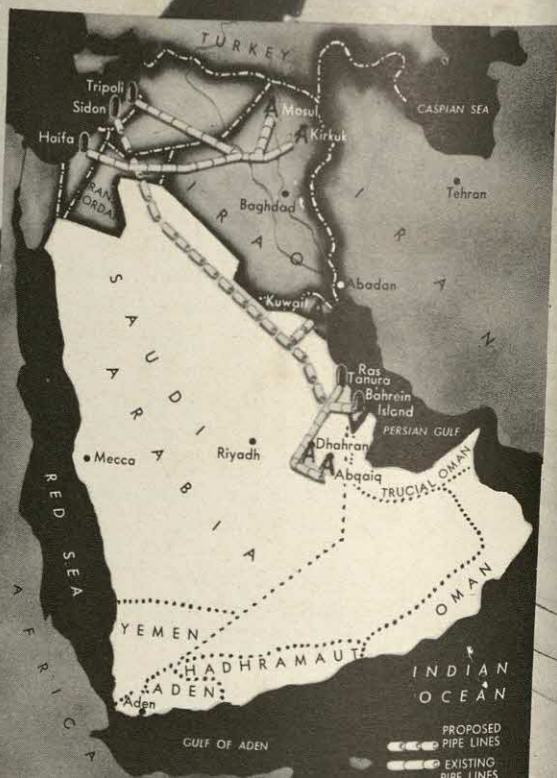
Out of Arabia came a light of learning that shone over the Mediterranean world during Europe's Dark Ages. As early as A.D. 754 the Arabs established the world's first drug stores (above). They preserved Greek and Roman knowledge of medicines and drugs, added to it, and passed it on to the Western World. Mongol invasions and the greed of Arab rulers eventually crippled this civilization. Today, Saudi Arabian farmers still work the land (below) with primitive implements.



ARABIA

Oil is becoming increasingly important to Arabia. Below:
The location of present and proposed pipelines. Picture:
An Arabian pipeline walker patrolling the line between
Abqaiq and Dhahran.

Arabian American Oil Co.





DESERT BEDOUINS AT HOME

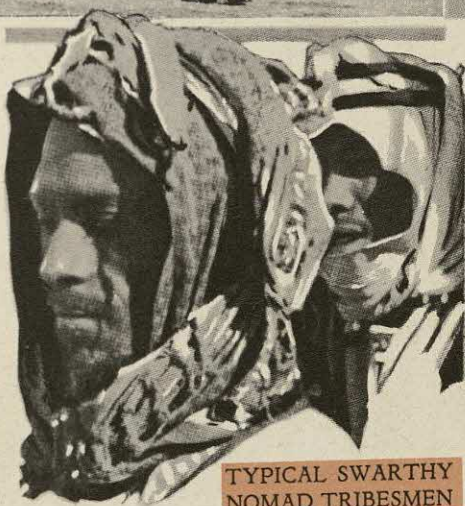
These nomads pitch their tents on the sandy wastes.

Present-day Arabia is not a united nation but is made up of several separate states. The largest of these states is the Kingdom of Saudi Arabia, a union of Hedjaz and Nejd. Saudi Arabia was created by a decree in 1932, with Ibn Sa'ud as king. In this kingdom lie the holy cities of Mecca and Medina. It is toward Mecca that Mohammedans throughout the world turn daily in their worship.

The Kingdom of Yemen, in the southwest corner of Arabia, is another important state. In 1934 it was conquered by Ibn Sa'ud, but not all the kingdom actually became a part of Saudi Arabia. Oman and Kuwait, in the eastern part of the peninsula, are also well-known states. Aden, at the southern tip of Arabia, is now a British protectorate. See ARABS.

ARABIAN NIGHTS. For hundreds of years the tales of Aladdin and his wonderful lamp, Sinbad the Sailor, and Ali Baba and the Forty Thieves have thrilled generations of readers, young and old, around the world. They are stories from the *Arabian Nights*, or "The Thousand and One Nights," that have come down to modern times through the Arabian people and have been translated into all languages. Only the Bible is more widely read.

How they came about is an exciting story in itself. Long ago, the legend has it, the great and powerful Sultan Shahriyar of Persia was disappointed in love. He decided that he would kill all his future wives the morning after his marriage.



TYPICAL SWARTHY
NOMAD TRIBESMEN

After a time he married a beautiful woman named Scheherazade, who decided she would stop this evil practice.

The night they were married, he commanded her to tell him a story. She began it, but when she came to an interesting part, she stopped. The sultan, in order to hear the rest of the tale, postponed her death until after the second night. Then, on the second night, Scheherazade told another story, leaving it unfinished, and this kept on for a thousand nights. In the meantime the sultan had fallen in love with her, and when she ended her "Thousand and One" stories, he allowed her to live.

The tales are supposed to have come from Persia to India, whence the Arabians took them and passed them on to the rest of the world. Probably no collection of stories ever written has been enjoyed more than these.

AR'ABS. The inhabitants of the peninsula of Arabia are known as Arabs. They are a dark-skinned, black-eyed, Semitic people with clear-cut features and slender, athletic bodies. In spite of the fact that in early days they were widely scattered throughout the Mediterranean region, they are today one of the purest races known. About one-half of the Arabs still live a wandering life, just as did their ancestors a thousand years ago—herding their camels, sheep, and goats and living in goatskin tents. The other half of the Arabs live a more settled life in cities or on farms.

The Arabs are active, intelligent, proud people, who are always courteous and generous to strangers. Yet, though one may be entertained royally in their homes or tents, the Arabs think it no sin to rob a guest after he has left their table. This is particularly true of the Bedouins, or wandering herdsmen. The custom has prevailed for centuries, for the Arabs have little idea of owning and keeping property.

Islam, the Arab religion, is also called Mohammedanism. It is divided into three sects—the Sunnites, the Shiites, and the Wahabis. All Moslems pray to Allah, or God, five times a day, turning their faces toward the holy city of Mecca in Arabia. Much of the most-read Arabian literature today is based on the Koran, the Mohammedan Bible. This book, written in pure Arabic, contains the teachings of Mohammed, collected after his death by the Caliph Abu-bekr. The Arabic language is a living dialect of the Semitic, and is notable for the richness and softness of its sounds.

During the Middle Ages, the Arabs became very powerful, and spread their learning throughout the Mediterranean countries. They wrote geographies and poetry and translated the tales of the famous *Arabian Nights*. They studied medicine, chemistry, and astronomy, building observatories in Baghdad and other cities. They introduced algebra and the Arabic system of numbers, 1, 2, 3, 4, etc., that we use today. They brought their swift horses to the Western world, and

today every thoroughbred racing horse has the strain of Arabian ancestors in its blood, showing in speed and stamina.

In architecture the Arabs also made valuable contributions, building many palaces and mosques noted for their beautifully decorated arches. In Spain, today, some of these buildings still stand.

The Arabs have become more important in world affairs, especially since the Persian Gulf area began producing petroleum. At the end of the Second World War, Syria, Lebanon, Jordan, Iraq, Saudi Arabia, Yemen, and Egypt had established themselves as free nations. See ARABIA; PALESTINE.

ARARAT, *air' a rat*, MOUNT. On the crest of Mount Ararat the ark of Noah is said to have touched land as the waters subsided after the great deluge and flood related in the Old Testament of the Bible. Its two volcanic cones, the higher one rising 17,260 feet above sea level—loftier than any mountain in this country—dominate an earthquake-ridden region of Armenia in Western Asia. In 1840 a terrible eruption of Mount Ararat hurled great masses of earth and rock into the plains below, destroying the gardens, convent, and chapel in the village of Arguri, and burying many people alive.

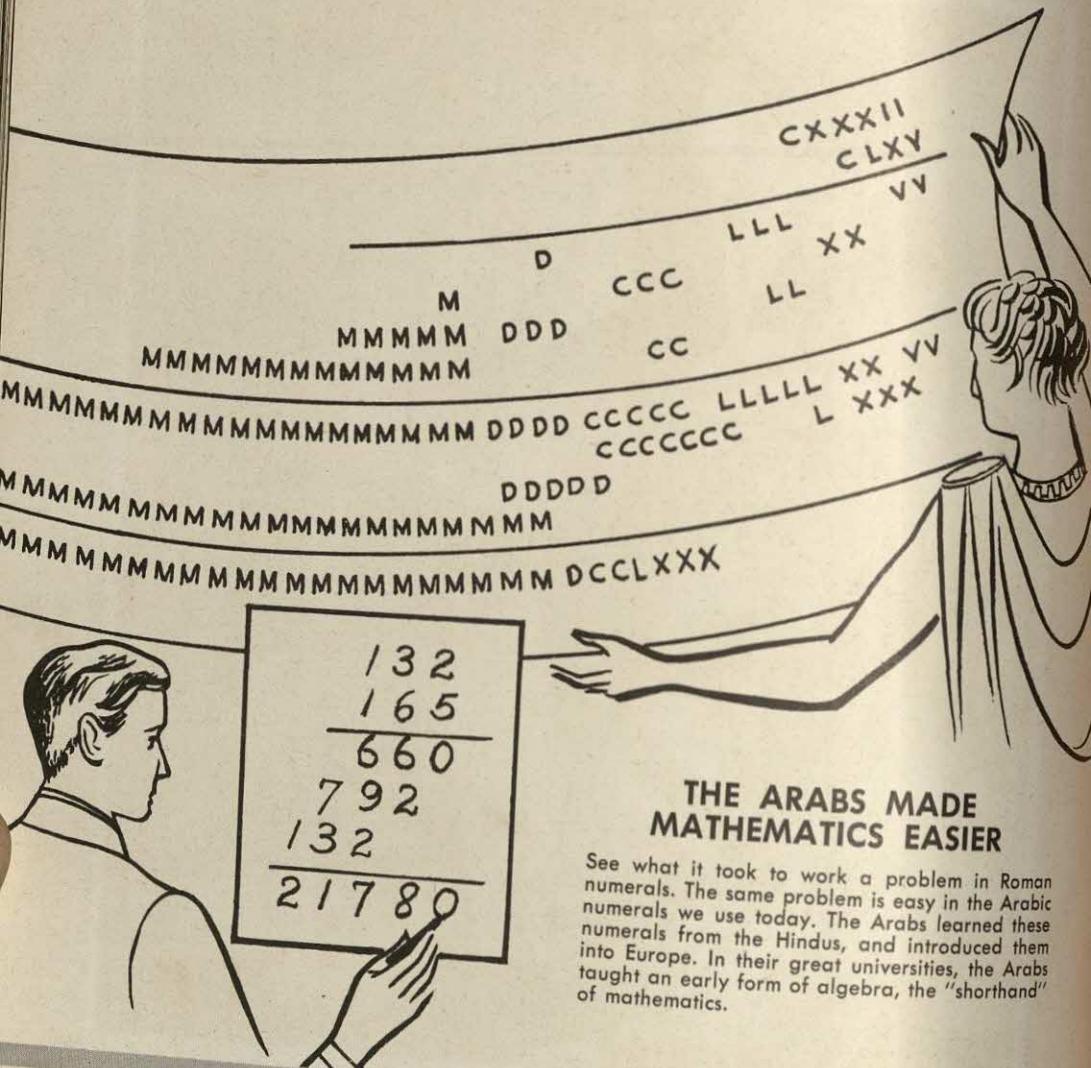
ARBOR DAY. In many states a day is designated by the legislatures for the voluntary planting of trees by the people. It is called Arbor Day. This observance was started in 1874 by the Nebraska state board of agriculture, at the suggestion of J. Sterling Morton, afterwards Secretary of Agriculture in President Cleveland's Cabinet. Nearly every state has since established an annual Arbor Day.

It is a day especially loved by school children, and several states publish small books of exercises and instructions for its observance in the schools. Arbor Day is held late in April, or early May in the Northern states, and between December and March in the South. The observance of this tree-planting day has also spread to Canada.



Bausch & Lomb Optical Co.

THE ARABS, HERE STUDYING LIGHT REFRACTION,
MADE SIGNIFICANT CONTRIBUTIONS TO CIVILIZATION



THE ARABS MADE MATHEMATICS EASIER

See what it took to work a problem in Roman numerals. The same problem is easy in the Arabic numerals we use today. The Arabs learned these numerals from the Hindus, and introduced them into Europe. In their great universities, the Arabs taught an early form of algebra, the "shorthand" of mathematics.

The Hindu and Arabic numerals included that almost magic symbol, the zero, which means simply "nothing" or "times ten." It does more than any other number to help us work problems quickly and easily.

This is how the Hindu and Arabic numerals looked, compared with those we use today.

HINDU

१ २ ३ ४ ५ ६ ७ ८ ९ ०

ARABIC

۱ ۲ ۳ ۴ ۵ ۶ ۷ ۸ ۹ ۰

MODERN

1 2 3 4 5 6 7 8 9 0

OX12 Add zero = 120
 00x12 Add two zeros = 1200
 10 of 1200 = 120
 1000 of 1200 = 1.20



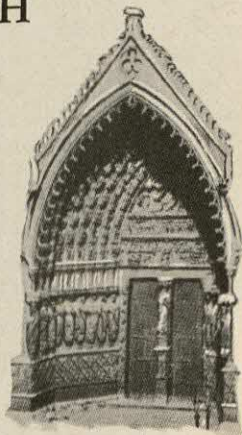
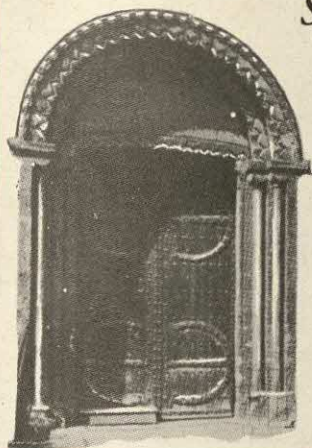
*Symbol of TRIUMPH
and SECURITY
the ARCH*

From ancient times the arch has been employed in architecture, not only to sustain a weight, but to commemorate great deeds and military triumphs.

Rome's massive Arch of Titus, built in 70 A. D. (above).

The semicircular Norman archway (left).

Gothic arches are always pointed (right).



ARCH. Amid such wonders as New York's tall Empire State Building and San Francisco's Golden Gate suspension bridge, the modern world still marvels at a trick of engineering that has been known from the beginning of civilization. This is the arch. The principle that gives the arch its strength is so simple that it has been used not only for the construction of bridges and coverings over entrances and roadways, but also for the manufacture of bottles and electric-light globes, for making bottoms of ships and dams, and for almost everything which must stand pressure from the outside.

Principle of the Arch. We can understand its principle by studying the simplest form of arch, the building arch often seen over doors and windows. The stones in the middle of an arch do not collapse because they are wedge-shaped; and, as a weight presses down upon them, they push against the stones below. Thus the pressure from above is merely passed on from stone to stone and finally to the pier or foundation on which the lowest ones rest. Each stone holds up the stones above. In this way the arch cannot fall unless the sides are pushed outward. This outward push is called *thrust*, which is comparatively easy to overcome.

In construction, the arches are usually held up by wooden frames until the middle stone is dropped into place. This stone is called the *keystone* because it seems to lock the entire arch. The lowest stone on either side is called the *springer*, and the highest part of the arch is the *crown*.

From Lintels to Steel Bridges. A form of the arch has been in use ever since man leaned two big stones together to cover an opening. About the simplest and oldest means of supporting a heavy weight or a structure over a doorway was the use of a single stone, or *lintel*, of sufficient length to be laid across the ends of the sides of the opening. This method met the needs, for the most part, of the early Egyptians, Assyrians, Etruscans, and Greeks, who were acquainted with the arch but used it

only occasionally. The Babylonians invented the curved arch, and the Egyptians used it, but for drains, not for buildings. The Romans employed the arch extensively and developed it to its highest type of usefulness, introducing it not only in their buildings, but also in their drains, aqueducts, and bridges (see **AQUEDUCT**).

The curved arch continued in use everywhere until the Middle Ages, when the pointed or Gothic form was introduced. Out of this arch many other forms developed.

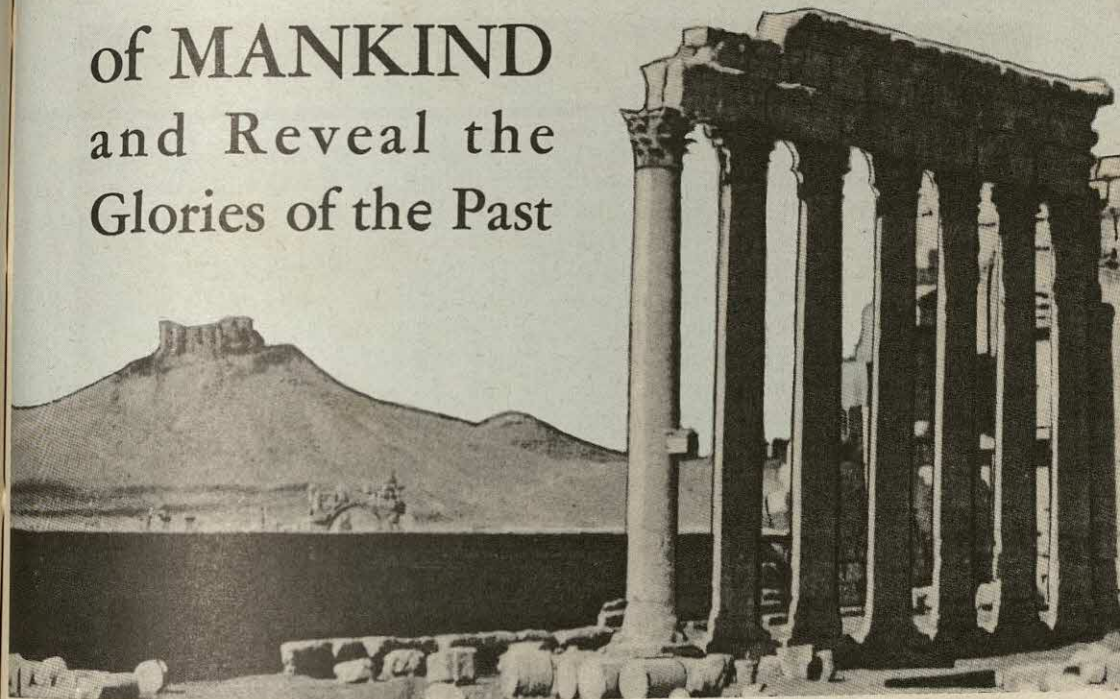
The longest stone span in the United States, and one of the two longest in the world, is the Cabin John Bridge, near Washington, D. C., with a span 220 feet long, a rise of 57 feet, and a width of 20 feet. An arch 251 feet across, the largest stone arch ever made, was built over the river Adda in Northern Italy in the latter part of the fourteenth century.

Famous steel arches include the one which supports the vehicle bridge below Niagara Falls, and those of Hell Gate Bridge, New York; Harbor Bridge, Sydney, Australia; Bayonne Bridge, between Staten Island and New Jersey; and the Zambezi Bridge near Victoria Falls, South Africa.

The Decorative Arch. Arches are used not only for constructive but also for decorative purposes. Sometimes a floral or light arch is built across a street on the occasion of some public event; again, single arches are erected for gateways or as memorials. The latter form, or *triumphal arch*, was originally a simple, decorated arch under which a victorious Roman general and army passed in triumph. During the Middle Ages the triumphal arch fell into disuse, but since the Renaissance many memorial arches have been built, and today they are generally popular.

The most famous of the Roman arches were the Arch of Titus, the Arch of Trajan, and the Arch of Constantine; the principal modern memorial arch is the Arch of Triumph at Paris, built during the time of Napoleon. See **BRIDGE**.

PROUD RUINS tell the STORY of MANKIND and Reveal the Glories of the Past



ARCHAEOLOGY, *ahr ke ol' oje*. Not long ago there was found in a bog in Northern Europe the skeleton of a man—murdered hundreds of years ago. Probably he was a Norseman of ancient times, whom someone had stabbed to death and then tossed in the marsh, to hide the evil deed. The discovery caused a sensation in our civilized world; but not because of the murder mystery it implied. Strangely, the swamp had preserved for centuries the clothing this man wore, and from it archaeologists could learn much of the manner in which men lived in his day and clime.

Archaeologists are the discoverers of our times—modern delvers into the long ago. They explore caves, they dig into the earth and sand to hunt for remnants of man's earlier civilizations, and from fragments of pottery, from bones, knives, and bows and arrows, from ancient carved pictures and from charred bits of wood, they study the history of man's early life on this world.

Mankind learned to write less than 6,000 years ago, and the prehistoric ages—the period before written history began—

would be unknown to us if the archaeologist did not unearth the unwritten lore of the human race. From a study of the tools used by early man, archaeologists divide the prehistoric period into the Stone Age, the Bronze Age, and the Iron Age. These are named for the materials then used. Stone or flint tools came first; and they continued to be used even after metal was introduced. Our modern age is sometimes called the Age of Steel.

Where Archaeologists Work. Early man lived in caves, on hills, or along river banks where he could find water, protection from the weather, and a haven from wild beasts and from his human enemies. If he deserted his cave home, he might leave behind enough for the archaeologist to read his life story, after the sand and dirt of ages was removed. Perhaps, however, he lived in a hut of stone or sun-dried brick. War, pestilence, or drought may have driven him from that home. After wind, rain, and sandstorms have caused the house to crumble, and grass and weeds have grown up to hide its ruins, there is but little left for a modern



This is what the archaeologist discovers with his scientific pick and shovel. The group above is examining a superb mosaic pavement at Carthage. And (below), the Temple of Thothmes III at Karnak, Egypt.

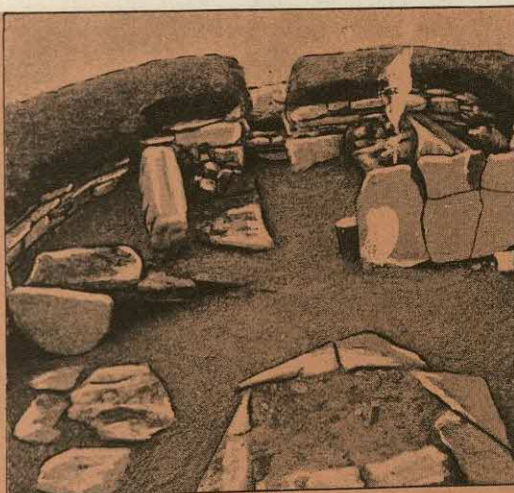
places. Many of their greatest discoveries have been in graves, for early peoples believed dead men needed material things in the next world, and they would bury their belongings with them. In Mesopotamia, even the wives and servants of kings and chieftains were killed and placed in the same tombs. Sometimes the tombs are found to contain records of the reign; priests have been found buried with prayers and lists of supplies in the temple storehouse; food and weapons, contracts and wills, all tell their stories about the lives of those long dead.

The airplane has become a valuable aid to the searcher. A flier may spot a lost city of the Mayas in the jungle of Central America. Photographs from the air may reveal the outlines of a buried temple. The ancient Roman roads across the Syrian desert or the wheat fields of England stand out magically in an aerial photograph, although they are difficult to see from the ground.

scientist to study in the desolate waste. But the swift tragedy that overtook Pompeii and Herculaneum, when the volcano Vesuvius suddenly erupted and buried them, was made to order for the archaeologists who have dug into dead cities in modern times. So suddenly did the showers of hot cinders and ashes rain down upon those ancient Roman towns, the people could not escape with their possessions, and under the hardened mass, excavators have found streets and houses preserved exactly as they were in life.

Archaeologists are found in strange

How They Go About It. When an archaeologist decides on a promising site for digging, he carefully maps the surface of the ground and divides it into squares



STONE AGE RELICS OF THE BRITISH ISLES

At left, Stonehenge, on Salisbury Plain, inscrutable mystery of prehistoric Britain. Built to face the rising sun in midsummer, this massive group of stones may have been a temple of the sun-worshippers. No one knows. Right, a community workshop of the Stone Age inhabitants of Skara Brae, in the Orkney Islands.

for systematic search. It may take years to uncover a hidden city. It is relatively easy to scoop away the sand covering old Egyptian ruins, but it is not so simple in Mesopotamia, where the ancient sun-dried bricks have decayed and mixed with the surrounding earth.

To break through the hardened crust covering Herculaneum, it was necessary to use compressed air drills such as you see breaking up our city pavements. Explorers in early villages of the American Indians often use spoons to scrape away the dirt, in order not to disturb the specimens they are excavating. Sometimes they sift the earth for tiny remnants that can be pieced together. Every find is recorded in a catalogue showing where and when it was found.

If walls must be removed to uncover hidden rooms, the bricks are numbered and replaced afterward in the same positions. It was in this way that some of the old buildings in Williamsburg, Va., were excavated and then restored in the 1930's, when that old colonial capital was rebuilt as it had been before Washington's time.

Archaeology a Recent Study. Scientific study of ancient remains started at

the beginning of the nineteenth century. Archaeological study at first centered in Greece, Italy, and other Mediterranean countries; today, sites in Persia, India, and the Americas are also being excavated by many scholars.

When Napoleon invaded Egypt, in 1798, he brought with him scholars who investigated the ancient remains of that country. Of outstanding importance was the discovery of the Rosetta Stone, in 1799. This is a black tablet containing the same inscription written in Greek, in modified Greek, or demotic, and in Egyptian hieroglyphics. Since scholars could read the Greek writing, the Rosetta Stone provided a means of deciphering the hieroglyphics on the walls of temples and tombs. It thus revealed the key to the strange writing that so long had baffled students of Old Egypt. The ancient cuneiform (wedge-shaped) writing of Mesopotamia was gradually deciphered by scholars, and with these writings understood, scholars were able to read and study the histories of many countries about which they had known little.

Tutankhamen. In Egypt, perhaps the most famous archaeological discovery of

recent years was the finding of the tomb of Tutankhamen in 1922, by Lord Carnarvon and Howard Carter. This Pharaoh was not so great and powerful as other Egyptian kings, but his tomb had never been plundered as had many others, and so it contained many beautiful and priceless treasures. The sealed door of the tomb was guarded by the statues of two servants; the coffin containing the mummy of the king was of solid gold. Fine linens and garments were found, as well as the king's chariot, his throne, and many of his household effects. For more than 3,000 years no one had entered the chambers of the tomb.

The Sphinx. In recent years the sand has been cleared away from in front of the Egyptian Sphinx, perhaps the most famous of monuments, disclosing a shrine between the enormous paws. But it was not the first time this huge image with the head of a man and body of a lion was salvaged from the desert; four times since 1420 B.C. the sands have been cleaned away.

Psousennes I. In 1940, Pierre Montet, a French archaeologist, discovered the tomb of Psousennes I, an Egyptian king of the eleventh century B.C. This king ruled at Tanis, on the site of the present town of San El Hagar, in the Nile Delta. Rich jewels were found in the silver mummy case. Inscriptions on the walls of the tomb give valued historical information.

Searching for Biblical Cities. Archaeologists for many years have excavated in Palestine, Syria, and Mesopotamia in search of the cities mentioned in the Bible. Almost nothing remains of Jerusalem from the time of Christ, but at Jericho there were uncovered the remains of the city destroyed by the Hebrews, as well as many earlier and still later cities on the same site.

Stables which may have sheltered the horses of King Solomon were uncovered on the southern edge of the plain of Esdraelon in the ancient city called Armageddon in the Bible. And in a seashore cave near Athlith nine almost complete

skeletons of a species of man from the Old Stone Age were found embedded in the rock. This is the largest and most important group of prehistoric skeletons ever found.

Recent work by the Germans in the Hittite capital of Boghaz Keui in Turkey has produced a large number of tablets and several inscriptions in both Hittite hieroglyphics and cuneiform. Most of these have been deciphered and published, but more than 2,500 are yet to be translated. In Mesopotamia the Germans have excavated the mighty city of Babylon, home of Hammurabi and Nebuchadnezzar, and the great Assyrian capital called Assur. Nineveh of Bible fame has been partly excavated.

A royal tomb at Ur is the most spectacular discovery made in Mesopotamia in recent years. The king and queen with all their household were still clothed in royal splendor, and their gold and silver drinking vessels, the harp which once entertained them with its music, and a large number of their servants were found buried with them. At Tell Asmar in the desert northeast of Baghdad, among ruins dated about 2500 B.C., were found bathrooms with equipment which rivals ours.

Restoring the Glory That Was Greece.

The modern Greeks are rapidly restoring the ruined architectural triumphs of their ancient forefathers. Work is in progress on the magnificent Temple of Athena, called the Parthenon. The structure was badly damaged during the Greek War for Independence from the Turks, for the Turkish army had stored gunpowder in the building, and an explosion almost destroyed it.

Archaeologists did not have to dig to find the Parthenon, for the huge, colonnaded temple is atop a hill known as the Acropolis. But there were a great many other buildings lower down on this hill which had to be unearthed in the usual manner. Among these were great amphitheaters and several smaller temples. The Parthenon is considered the highest achievement of the architects and sculptors

of the Golden Age of Greece. Its restoration by archaeologists soon will be complete.

American archaeologists recently began large-scale excavations in the center of the city of Athens. Several modern buildings were torn down, and a search was begun for the remains of an ancient market place, mentioned in early writings but never discovered. The scientists have found the masonry outlines of a number of buildings, and many valuable and interesting pieces of pottery and statuary have been taken from the ruins. Ancient Greek writings, incidentally, have led to much of the archaeological exploration and discovery in Greece. And descriptions of long-buried buildings and art works have helped immeasurably in identifying and restoring the relics.

Lying in the Mediterranean sea not far from Greece, Cyprus has become a veritable "Treasure Island" for archaeologists. A great palace, uncovered at Vouni, was found to contain many indications of a well-developed civilization. The palace itself is on a grand scale, its remains indicating that it once had about 200 rooms. But it is the ornaments and jewelry which show the great skill of the artists of the day. The scientists have evidence that this civilization on the tiny island was at its height about the fifth century B. C. Superb examples of the art of the goldsmith and silver worker have been rescued from the accumulated sands and rubble of the past 2,500 years.

Excavations in Modern Rome. Perhaps more is known about the ancient Romans and their ways of life than about any other civilization of ancient days. Much of

this knowledge must be credited to the archaeologist and his extensive explorations. Most of the splendor of Roman art and architecture has been found in the city of Rome itself. A large number of buildings survived the vandalism of the Dark Ages and the ravages of time. But dirt and debris had to be removed before any of the buildings could be examined. Even the famous Roman Forum, now completely uncovered, stands on ground well below the level of the modern streets around it. This and other Roman ruins have provided us with some of our most treasured works of art.

The latest archaeological project in Rome was the removal of a large block of relatively modern slums which lay between the Forum of the Caesars and the later Forum of Trajan. Beneath the slums were found a number of complete ancient buildings, some of them several stories high. Though they

were mentioned in early records, they had been completely buried under the advance of modern civilization. Unlike the cities of Pompeii and Herculaneum, Rome was not buried in hardened volcanic matter, and digging presents no such tremendous difficulties. But the dirt and dust and debris may pile deep and thick in seven or eight centuries.

The Land of Xerxes. One of the storied cities of antiquity was ancient Persepolis, capital of Persia. Now nothing remains but a few huge marble columns, massive walls, and sculptures. In 331 B. C. the city was conquered by Alexander the Great, who partly demolished it. Later it was rebuilt, and once again laid low. Only recently archaeologists have been working



MUSIC MAKER

Part of an ancient Peruvian vase made in the shape of a piper.

on the ruins of the once great Persian capital. They have dug up grand staircases of the palace of Darius I, and two superb pieces of wall sculpture. These have carved figures representing two of the early nation's rulers—Xerxes, most famous of all Persian kings, and Darius.

Secrets of the New World. The early explorers in North America found a flourishing civilization in South America, Central America, and Mexico. The people—Incas, Mayans, Toltecs, and Aztecs—left many traces of a highly developed civilization which flourished, independent of outside influences, centuries before the arrival of the first Europeans in the Western Hemisphere. Archaeologists are conducting thoroughgoing investigations of their life. Huge pyramids designed to support temple structures and shrines—rather than to be used as tombs, as was the case in Egypt—have been found at Chichen-Itza, the Mayan capital in Yucatan, and at many other places in Central America and southern Mexico. The greatest of all American pyramids is in the ancient Toltec capital of Teotihuacan near Mexico City; this is known as the Pyramid of the Sun. Some prehistoric American monuments have been discovered deep in the jungle, when airplanes have been pressed into the search for more relics.

The explorers at one time received the assistance of the noted aviator Colonel Charles A. Lindbergh, who spent some time flying over the Mexican and Central American jungle and showed a keen interest in its lost temples.

One Mayan pyramid is built around another smaller one. And inside the little temple atop the inner pyramid was found one of the finest known examples of Mayan art—a brightly colored, jeweled statue of a jaguar. The animal is carved out of a single stone, and is believed to have been used as an altar. Archaeologists established themselves near the pyramid to continue recovery and restoration.

The Aztecs of Central Mexico left metal work, pottery, sculpture, and other art

forms—sometimes preserved in buildings, sometimes buried in rubble.

But archaeological exploration in the New World is not limited to Mexico and Central America. Expeditions are carrying on investigations in the southwestern section of the United States. Early Indian peoples reached a fairly advanced state of civilization in New Mexico and Arizona. The best known of these were the Pueblos, who lived in houses built of stone and dried mud called adobe and sometimes totalling hundreds of rooms. Many buildings of this type are still in use by descendants of these ancient Southwestern people, such as the Hopi and Zuni Indians.

Much of the modern archaeological investigation in this region is largely confined to the examination of the buildings, the buried skeletons of the ancient people, and the tools and ornaments they used. In cliff ruins and caves where handicrafts were protected from the destructive forces of nature, the archaeologist often finds centuries-old baskets, cloth, fiber sandals, and other perishable goods. Such relics were found in Mammoth Cave, in Kentucky.

As is so often the case, the most fertile field for the archaeologist in the United States is the tomb. Indian tribes in many parts of the country used to build burial or ceremonial mounds in the earth. In these they not only placed their dead, but buried considerable property. Burial and ceremonial mounds are found in great numbers in Wisconsin and Illinois, where they range from small round or oval graves to great, sprawling animal figures. See MOUND BUILDERS.

Archaeology is a growing science which presses into service all other science—an art which embraces all the arts of time. See AGE OF MAN; BRONZE AGE; IRON AGE; STONE AGE.

ARCHANGEL, *ark' ayn jel*. There are ranks even among the angels, in the belief of many sections of the Christian Church. Of the seven orders of angels, highest is the archangel. The Bible has identified some of the archangels. The *Book of Jude*

refers to the archangel Michael, and in *First Thessalonians* IV, 13, Saint Paul makes reference to the Lord as an archangel.

ARCH-BISHOP. The chief bishop of a church province, or *see*, is the archbishop. The title originated in the fourth century, and the office is recognized in the Anglican, Roman Catholic, and Greek churches. The archbishop of Rome is the Pope, and the patriarch of Moscow held a similar position in the Greek Church.

England has two archbishops, one at Canterbury and the other at York. The Archbishop of Canterbury is called Primate of all England, and has supreme authority over the Anglican Church in the British Isles. The Roman Catholic is the only Church maintaining the office of archbishop in the United States. See BISHOP.

ARCHER-FISH. One of Nature's strangest creations is the archer-fish, which shoots down its insect prey from the air. Rising to the surface, the fish squirts a drop of water from its mouth with marvellous accuracy, striking a bug three or four feet away and then swallowing the insect as it falls to the surface. It is a spiny fish, six inches long, living in the ocean around Java.

ARCH'ERY. If you had lived in the days of Robin Hood, if you had been an Indian lad in the forests of America a century ago, your life might have depended on your skill with the bow and arrow. Until the invention of firearms, the arrow was one of the principal weapons of the warrior and the huntsman. Archery today, except in most primitive and savage lands, is merely the game of shooting an arrow at a ringed target, with the highest score

for striking the bull's-eye at the center.

The use of these weapons in war and the chase dates from earliest times. The Bible tells us, in *Genesis* XXI, that Ishmael "became an archer." The Egyptians, Assyrians, Persians, and Parthians excelled in the use of the bow, and while the Greeks and Romans themselves made little use of it, they employed foreign archers as paid soldiers. The credit for the victories of the English army at Crécy, Poitiers, and Agincourt may be given to the bowmen. Archery disappeared gradually as firearms came into use, although even in the early part of the nineteenth century the North American Indians were using the bow and arrow and were still frightened by the noise of gunfire.

Archery is well liked as a healthful recreation. In recent years a number of archery clubs have been formed in the United States and Canada, and interest is increased by

the fact that it is an open-air sport for women as well as men.

ARCHIMEDES, *ahr ki me'deez* (287-212 B. C.). When you puzzle over hard problems of arithmetic or geometry, remember old Archimedes, who was writing books on plane and solid geometry, arithmetic, and mechanics more than 200 years before Christ. A native of Syracuse in Sicily, he discovered the principle of the lever and of specific gravity; he invented a tubular screw for raising water; he invented engines to hurl weapons of war.

During the siege of Syracuse, he set fire to the Roman fleet with his burning glasses. Having rebuked a Roman soldier who invaded his study, while he was working on geometry, Archimedes was brutally killed with the sword.



A TWENTIETH-CENTURY
DIANA
Archery is now a popular sport.



from MUD to MARBLE the Story of the BUILDER'S ART

ARCHITECTURE, *ahr'ki tek ture.*

What a dreary world this would be if all homes and buildings looked alike! It might be cheaper to build standardized houses, stores, and churches, but it would be much less interesting than planning each building to fit its own location and purpose. Even the savages of Africa want their homes to be varied and ornamented; they share the universal desire of man to stamp his dwelling with individuality.

While it is true that some buildings are drab and ugly, many are pleasing to the eye. Usually, the latter kinds are built by men who know the secret of making homes and buildings beautiful, as well as strong and useful; by men called *architects*, from the Greek for *chief builders*. The art and skill they practice is *architecture*.

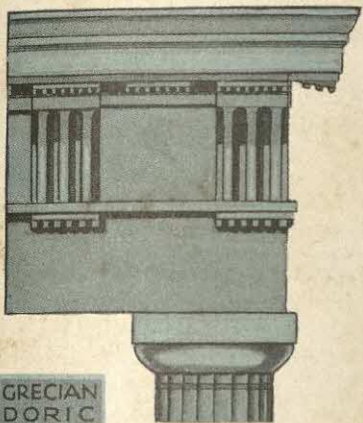
What makes one building ugly, and another attractive? This question is not always easy to answer; it is sometimes difficult to explain exactly why you admire

a certain painting, or your newest dress, or the wallpaper pattern in your bedroom. One can look admiringly at a new home or a towering church spire, and feel a sense of enjoyment without knowing just why. Just the same, every boy and girl has often wondered how our buildings came to be as they are—instead of being like the fanciful structures you might imagine exist on the moon.

The art of building for utility and beauty has grown from the natural needs and desires of man in all the different periods of history. Let us transport ourselves back to the beginning, and, journeying through some of the great periods of architecture, see how these needs were met by people of different ages and countries.

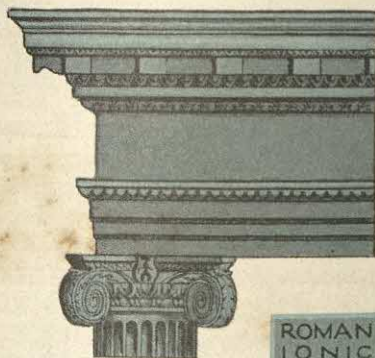
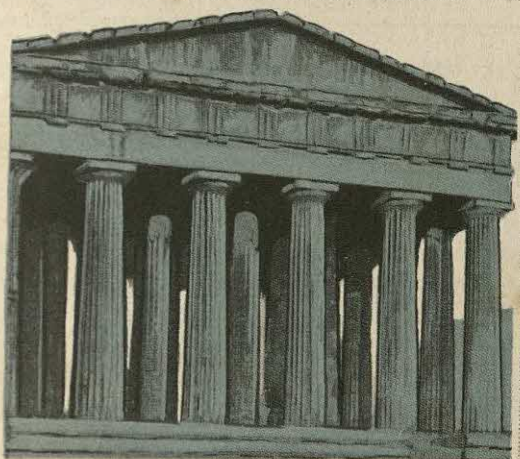
Architecture as Old as History. Our trip begins back in 4000 B. C., in sand-blown Asia Minor. In most parts of the world, at this time, men still live in rude huts or caves, built merely for shelter. But in Asia Minor, builders have begun to take pride in the way their buildings look. They erect walls more carefully and even build palaces of stone that shimmer in the sun—as modern explorers have since discovered.

We know so little about these buildings, as yet; let us hasten through several centuries, across the Red Sea, to ancient Egypt. It is now 2000 B. C., and we find ourselves in the midst of a magnificence the world has never seen before. Already Egyptian kings have founded a great civilization and copied the art of building from Asia Minor. But how much more beautifully and grandly the Egyptians have learned to fashion. Not content with



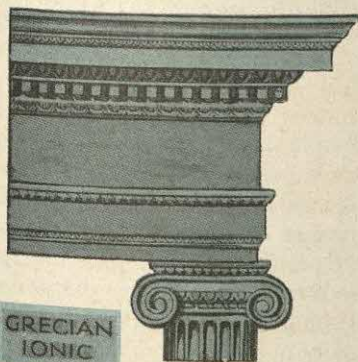
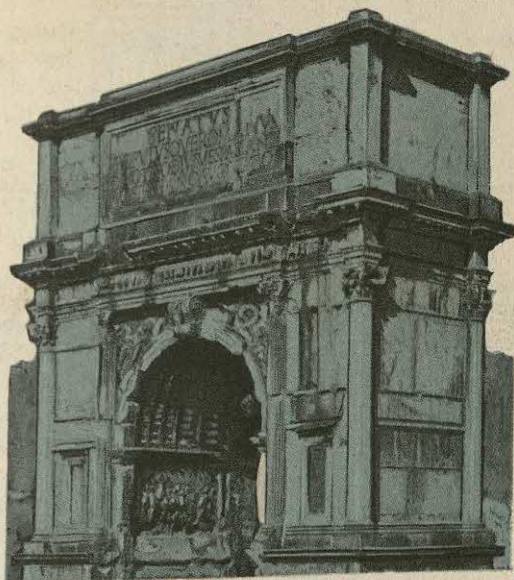
GRECIAN
DORIC

Oldest of Greek architectural styles, the Doric column was used in many stately buildings, like the Theseum at Athens (right).



ROMAN
IONIC

The Romans changed the second Greek order, Ionic, and adapted it to such monumental structures as the Arch of Titus (right).



GRECIAN
IONIC

This is the original Greek Ionic, or scroll capital. Columns in this style line the Temple of Wingless Victory (right).



AN ILLUSTRATED GLOSSARY OF ARCHITECTURAL TERMS

GABLE ROOF — a roof that forms a gable, or triangle of wall surface, at its ends.



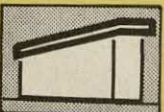
HIPPED ROOF — a roof that slopes gently from its center ridge, bounded by "hips," at its ends.



GAMBREL ROOF — a roof that slopes gently from its center ridge and then drops more sharply.



SHED ROOF — a ridgeless roof that slopes in a single direction from its highest point.



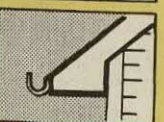
DORMER WINDOW — a vertical window that is set into the slope of a roof.



CUPOLA — a small dome; in popular usage, a "lookout" structure on top of a building.



EAVES — the overhanging edge of a roof, usually equipped with gutters to carry off rain water.



CANTILEVER — a load-carrying beam supported at only one end, much used in modern building.



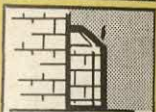
BATTLEMENT — a notched parapet, often accompanied by a projecting, defensive bastion.



TURRET — a small tower rising above the main structure, common in medieval architecture.



BUTTRESS — a supporting structure used to help a wall resist an outward thrust.



FLYING BUTTRESS — a buttress built at a distance from a wall and joined to it by a half arch.



BAY WINDOW — a window projecting from the first floor and sometimes extending to the roof.



ORIEL WINDOW — a type of bay window projecting from an upper floor of a building.



LANCET WINDOW — a narrow window with pointed arch, common in English Gothic architecture.



FANLIGHT — a semicircular window with fanlike ribs, used over doors in Georgian architecture.



the irregularly shaped structures of Arabia, they chisel stone blocks that fit closely together, making smooth walls and square corners.

As we journey from 2000 to 500 B. C., we watch thousands of slaves toiling in the hot sun to give the world its first great architecture.

This period of architectural greatness—like later periods to come—results from a strong, central idea that fires the imaginations of the people. In Egypt, this idea is immortality of the soul. The great Egyptian temples and pyramids are really tombs. The rulers often spend their whole lives and much of the wealth of the kingdom to build these tombs where their

bodies may be laid safely away as eternal habitations of their souls.

What are those huge rows of stone shafts or posts around the temples? They are *columns*. The Egyptians are the first to use columns that are not just supports for the roof, but an important new means of beauty. Rows of columns make an imposing sight—like giants standing on parade! As our make-believe journey takes us on, through reign after reign of Egyptian kings, we see sculptors and artists making columns more and more ornamental. Copying mostly from Nature, they fashion the tops of the columns in the form of papyrus leaves, lotus buds, or palm leaves. They make their columns bulge slightly at the middle, like bundles of reeds tied at top and bottom, to give a more pleasing appearance.

Then comes more sculpture. Enormous statues of gods, sphinxes, and animals adorn Egypt's temples.

The most famous structures of old Egypt are the pyramids. The Great Pyramid, one of the Seven Wonders of the Ancient World, covers thirteen acres. It is 482 feet high, or as tall as all but the highest modern skyscrapers.

During our journey thus far, we have traveled through Time from 4000 B. C. to about 500 B. C. Our next big scene of building splendor is Greece. On our way there from Egypt, we pass again through Asia Minor. Here now are the magnificent brightly colored palaces of the Assyrians and the Chaldeans. Unlike the Egyptian temples of stone, built to survive the centuries, these palaces of the East are doomed to crumble. For they are mostly sun-baked bricks of clay. But, look! the Assyrians have invented something new—arched roofs.

We may travel farther East, to see more wonders. The oldest architecture of early India is found in the Buddhist towers, which house relics of Buddha or some noted saint. In this land, also, the Hindus and Brahmans build curious temples shaped like pyramids.

A Beauty That Will Never Die. Now our make-believe journey brings us to perhaps the most wonderful chapter in the story of architecture. As we journey into Athens, Greece, it is 440 B. C. The city is enjoying peace and security. It is the Golden Age of Greek architecture. In the years just past, during the life of the great leader and statesman, Pericles, many great temples have been built. We rub our eyes, for have not the Greeks borrowed ideas from Egypt? It is true, but the Greeks have perfected three "styles," or orders, as they are called, which are entirely new. These are known as the *Doric*, *Ionic*, and *Corinthian*. Each order differs from the other mainly in the design of the columns and the capitals, for the Greek temples and buildings and even homes of this period are simply great rows of columns holding up a low roof, with a shrine or inner room within.

Can it be that here, at last, we can learn why buildings are beautiful? Yes! These early Greeks, for the first time, have *thought out the rules of beauty*. One rule is the rule of *unity*, or one-ness. All parts of the building should seem joined. A second rule is *harmony*; all parts should seem to belong to each other. Another is *emphasis*; certain features should be more noticeable, and others act as decoration. Then there will not be hundreds of details of the building all clamoring for attention at the same time. Proper emphasis prevents confusion and monotony.

A fourth secret is *proportion*, or the relation of different parts of the building. For some mysterious reason, wall areas that are nearly square seem awkward, while shapes that are longer one way than the other (like the page of this book) seem more satisfying to the eye. *Symmetry*, too, is a basic principle—that the parts to the right and the left of the center should be the same.

The Greeks learned to play tricks on the eye. On finding that perfectly level foundation lines *looked* as if they were *sagging*, what did these expert builders do

but *hump* the lines slightly in the middle to make them look straight! And they tipped the corner columns slightly inward at the top, to keep them from appearing to lean out.

Another rule was "nothing too much"—each detail just the right size, neither too big nor too small. The Greeks knew that too thick a column spoiled the looks of a building just as surely as ill-shapen features mar the human face. Too thin columns, on the other hand, look weak, and give a general appearance of insecurity.

The most famous Greek temple is the Parthenon at Athens.

As we prepare to take leave of Greece we pause in wonderment at this building, with its simplicity and perfection of form. Although we have learned some secrets of its beauty, still our imaginations are stirred by those artists whose genius led them to pioneer.

We especially regard with awe their ability to carve perfect statues and flowery designs out of white marble.

Rome, the Magnificent. It is now about 50 B. C. in our journey, and we find ourselves in Rome. Rome is already venerable, seven hundred years old. It is a great city of brick and stone, but shows none of that marble splendor which is to appear in the next three centuries. The Roman Empire is at the height of its power. Greece is part of this empire, and we see the finest of the Greek architects, plans in hand, directing the construction of great Roman temples, amphitheaters, public baths, triumphal arches, forums (public meeting places), and villas or homes of the rich. The architecture shows Greek influence, but is more elaborate than anything the Athenians ever dreamed of.

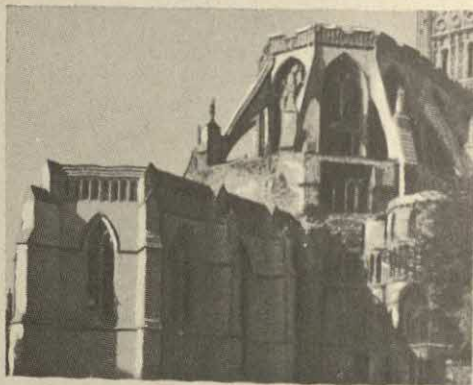
The Greek temples were simple four-

sided affairs, but the Romans build vast labyrinths of rooms, porches, halls, and passageways. Columns are topped with graceful half-circles or arches, which the Greeks knew but disdained to use. Halls as big as the waiting rooms of twentieth-century railway terminals are roofed with sweeping *domes*—another new means of achieving architectural beauty.

Some of the columns are Doric, Ionic, or Corinthian, as in Greece, but the Romans have invented two new styles, known as *Tuscan* and *Composite*. The Compos-

ite is really the Corinthian leaves and Ionic scroll joined together into one design.

One of the most remarkable Roman buildings is the Colosseum, where 80,000 people can gather to watch combats and games of the gladiators. Even the great college football stadiums of 2,000 years later are little larger.



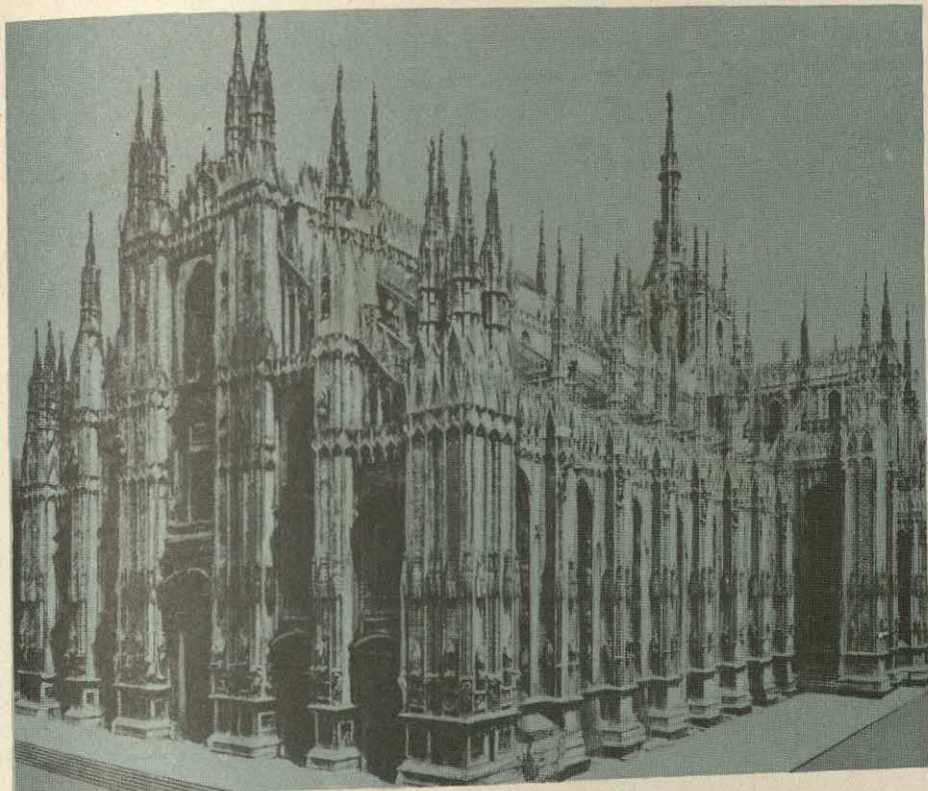
THE FLYING BUTTRESS

Gothic arches are supported by flying buttresses, eliminating the need for thick walls.

After A. D. 138, when Hadrian is buried in his tomb by the Tiber River, Rome begins to decline, both in political power and in architectural taste.

Architecture Spreads Through Europe.

The year A. D. 550 finds our architectural sight-seeing party at Constantinople, home of the conquerors of once-proud Rome. A new inspiration has gripped the builders of this region, and on all sides is the strange, half-Oriental, domed architecture destined to be used by the Greek Church for the next 600 years. *Byzantine* is the name for this style of architecture. The most beautiful and luxurious example is the Church of Saint Sophia (still standing today, after fourteen centuries). The Byzantine artists spend years decorating walls and ceilings with bright tile and marble mosaics (designs made of small pieces of colored marble cemented together). Much



THE LOFTY SPIRES OF MILAN

Milan, Italy, contains one of the best-known cathedrals in the world. Faced with marble, crowned with a forest of spires and statues, it is a masterpiece of Italian Gothic architecture.

of the fine marble is plunder from early Greek temples.

Byzantine architecture has spread through Italy, Russia, and Asia; Saint Mark's Cathedral in Venice is one example of the later expressions of this style. As our journey progresses through twelfth- and thirteenth-century Italy, France, and Germany, we come upon still another type of beautiful building, called *Romanesque*. One of the finest Romanesque buildings is the Church of Sant' Ambrogio, in Milan.

Meanwhile, in Spain, dark-skinned artisans, not to be outdone, have erected exotic castles of *Arabesque* style, such as the Alhambra or *red castle* of the Moorish kings of Granada, and the Alcazars of Seville and Toledo. They are copied from buildings of Arabia, hence the name, *Arabesque*. Ornaments fashioned from copper and iron and leather are a special

mark of this style, as is also the arched doorway. Much of the beauty of these Spanish castles is in the interior treatment.

Cathedrals That Took a Hundred Years to Build. Our student party now experiences a new thrill! It is about A. D. 1150. We are in France. As we pass from city to city, everywhere men are working like spiders high up in buildings different from anything we have ever seen before—*Gothic* cathedrals! What started all this feverish competition to build churches with ceilings a hundred feet high? It does not take long to find out. Someone has discovered a cheaper, easier way to build. For centuries the poor half-starved people of the Middle Ages have admired the slave-built stone buildings left by the Romans.

But no one but an emperor can afford buildings with such thick walls. Then



MAN BUILDS TOWARD THE SKY

The Bank of Nova Scotia building in Toronto was built many stories high because land is precious in the heart of a modern city. The Oriental pagoda has many stories because it is a place of worship, reaching upward toward Heaven.

suddenly, a daring builder invents ways to make thin walls and ceilings carry the weight of high cathedrals. Thin stone walls, it is found, can be braced with graceful stone props, called "flying buttresses." And thin ceilings can be given ribs, like an upside-down umbrella, by making the columns go on up and gradually bend over, until their top ends brace each other. "Vaulted" ceilings, as we call this Gothic type, are widely used to this day.

In the short space of seventy-five years, hundreds of cathedrals are built in France and Germany, whole cities toiling to outdo each other in splendor. Stone workers, by 1225, invent many new beauty ideas. For example, arches are no longer round, but gracefully pointed at the top. Big walls are made to look light and graceful by covering them with delicate designs and grotesque stone-carved "gargoyles," or fig-

ures of dragons, gnomes, and dwarfs. Architects create great lace-patterned windows, such as the exquisite rose window of Reims Cathedral.

Some of the Gothic cathedrals are a hundred years in the building. That at Cologne, Germany, begun in 1248, is not entirely finished until six centuries pass! Its towers rise more than 500 feet above the town.

The Era of the Renaissance. In England the *Elizabethan*, *Tudor*, and *Georgian* styles flourish. In France the *Norman* style is given to great castles or chateaux. To Italy comes the *Flamboyant*. We cannot visit them all, but one other style is worthy of a pause. That is the *Renaissance*, so named because it came with a renaissance or re-discovery of the fine architecture of early Rome.

Renaissance buildings are a mixture of

Greek, Roman, and other old forms of beauty. So we take one last quick visit to Italy, where in the year 1500, cities are busy erecting bell towers or "campaniles," abbeys, monasteries, churches, homes, and public buildings. The campanile at Florence is one of the most beautiful examples of this style. Another is the famous Leaning Tower of Pisa. Saint Peter's at Rome, one of the biggest churches in the world, is of this style. Its Renaissance architecture is marked by very fine and elaborate sculpturing and designs, by such great artists as Michaelangelo and Raphael.

Early Americans, too, Created Beautiful Buildings. So our journey brings us home at last, but not yet to the time of today. Even the early American pioneers found time to beautify their homes and public buildings. Who could imagine a more graceful spire than that of Independence Hall at Philadelphia? This building was erected in 1729, before the Revolutionary War. Colonial homes, like Mount Vernon, too, were given the grace that made Greek architecture endure. Even earlier, the Spaniards built fine churches in Florida and Texas, and we may still admire the Spanish missions of old California.

Which Style of House Is Yours? Today we have many styles of homes. Some are of envied beauty. Others are no longer fashionable, because architecture, like clothes, sometimes goes out of style. How did these styles come to be? During colonial days *Cape Cod*, *Dutch Colonial*, and certain other styles were the natural outgrowth of using wood, then cheap and plentiful. *Norman* style homes, on the other hand, grew from the use of stone. *Spanish* and *Mexican* styles were created with adobe and stucco. *Modern* or flat-roofed, rectangular designs are now made by using strong concrete and steel. In warm climates, styles are favored that spread over more ground, partly because basements are not needed for furnaces.

The Skyscraper Is Born. In our country you see every kind of style in archi-



Brazilian Government Trade Bureau

CLEAN, LIGHT, AND AIRY

Modern architecture, as represented by this government building in Rio de Janeiro, is designed for comfortable, efficient living

itecture, copied from all over the world. But one style is really an American development—the "skyscraper." Buildings were built taller and taller, as American cities grew, so that landowners could get more rent. Ten stories used to be considered very high until late in the nineteenth century. Then came the modern elevator, and the steel "skeleton" which carries the weight of the structure, thus permitting thin walls and great height.

Old castles and cathedral walls were made of stones, piled one on another from bottom to top. Now the "stones" in a skyscraper's walls do not rest on each other, but are hung on to very strong hidden frames of steel and concrete. The first skyscraper was built in Chicago in 1880. For many years the Woolworth Building in New York was the highest building, a modern wonder of fifty-five stories. But today that proud honor goes to the Empire

State Building, also in New York. Towering 1,250 feet, or nearly a quarter of a mile, into the air, it is 102 stories high.

Tall, solidly built structures cut off light and air. To solve this problem, some builders have used the "set-back" style of architecture. Others have made their outside walls almost entirely of glass and have relied upon air conditioning for ventilation.

ARCTIC, *ahrk'tik*, **CIRCLE**. The term *Arctic* comes from *Arktos*, the Greek name of the northern constellation called the Bear. The term is now applied to all the land and water north of the Arctic Circle, the imaginary line girdling the earth parallel to the equator and 23° and 30' from the North Pole. The Circle separates the North Temperate Zone from the North Frigid Zone. It also marks the southern limit of the sun's rays shining over the North Pole in summertime.

ARCTIC OCEAN AND LANDS. Although the Arctic is the earth's smallest ocean, it covers over 5,000,000 square miles and averages nearly a mile in depth. Around the North Pole, located near its center, it is a great frozen sea of rough, drifting "pack-ice," too thick for any ship to push through. Farther south, where warm ocean currents flow through the Arctic, navigation is possible part or all of the year, but strong-bowed icebreakers are often needed to clear paths through the floating ice-blocks. Both the Labrador Current, cause of Newfoundland's enshrouding fogs, and the huge, dangerous icebergs of the North Atlantic originate there.

Numerous islands, including most of Greenland, fleck this northernmost sea. Also extending north of the Arctic Circle are the northern tips of Europe, Asia, and North America. Although Soviet Russia and Canada own most of the Arctic's land, the United States (in Alaska), Denmark (in Greenland), Norway, Sweden, and Finland also have territory there.

The Arctic is known as the "land of the midnight sun" because it has from twenty-

four hours of daylight, at the Arctic Circle on the first day of summer, to six months of continuous light, at the North Pole. In winter, night is unbroken for twenty-four hours at the Circle, and for six months at the Pole. The "top of the world" is also the land of the beautiful "northern lights." See *AURORA BOREALIS*.

In the Lena River Valley of Siberia, which has the coldest winters of any inhabited place on earth, temperatures have dropped as low as 90° below zero. But when summer comes, the ice and snow melt, the ground thaws, though never for more than two feet, and temperatures of well above 70° are not uncommon. In fact, much of the Arctic's land sheds its icy blanket during its short summers, and some sections even grow vegetables, berries, and flowers. On a summer visit to the bleak, treeless coast, you would find that the winter's ice and snow had melted, turning the tundra into a marshy plain, carpeted with grass, lichens, mosses, blooming wildflowers, and low shrubs, over which butterflies and other insects flutter. Farther south, you would even see great forests of evergreens and a few stunted hardwoods.

Seals, walruses, polar bears, and excellent fishes provide food and clothing for Arctic dwellers. Whales and musk oxen are becoming scarce, but reindeer are herded. Ermines, martens, sables, muskrats, minks, foxes, and hares are trapped; sea and land birds are abundant.

From Arctic Greenland comes all the cryolite used in making aluminum; from Spitsbergen and elsewhere, large supplies of coal. Other minerals found in the Far North include gold, copper, iron ore, oil, natural gas, and pitchblende, a source of radium and uranium. Although much of the Arctic is still unexplored, undeveloped, and slightly populated, it is now considered a potential treasure house of far greater mineral wealth.

Until fairly recent times, the Arctic was settled chiefly by Eskimos, Lapps, and a few white pioneers. After 1915, however,

Soviet Russia led not only in Arctic exploration, but also in developing her extensive Far Northern area. Murmansk, for example, was turned into a great port, much used during World War II, and became the largest city north of the Arctic Circle, with a population of over 100,000. After the war, Norway also began to spend millions on the economic development of her Arctic.

Realizing that the Arctic is America's first line of defense against transpolar air attack, the United States and Canada also took more interest in their northern areas during and after World War II. Among other things, they jointly constructed a radar network across the top of the continent, mostly north of the Arctic Circle. New air fields and weather and radio stations were built there, and more scientists and military personnel were sent in to step up the two nations' Arctic observation and research work. In the Canadian Arctic, mineral deposits, including pitchblende, were discovered, and their exploitation was begun. New airlines and even some roads were built for carrying passengers and freight to and from the sites of these rapidly increasing mining and defense activities.

As any global map shows, the shortest routes between Eurasia and North America lie across the frozen Arctic wastes. Consequently, more and more people now talk of the desirability of opening up commercial airways straight across the top of the world. See ANTARCTICA; ESKIMO; LAPLAND; NORTH POLAR EXPLORATION; NORTH-WEST PASSAGE.

ARGENTINA, *ahr jen té' na*. Except for Brazil, Argentina is the largest, most populated country of South America. To be sure, little of the silver for which it is named has ever come from the "Silver Republic," or República Argentina, as it is officially called. But its favorable climate, fertile soils, and vast "seas of grass" enable it to be one of the world's greatest exporters of wheat, corn, meats, wools, hides, and tallow.

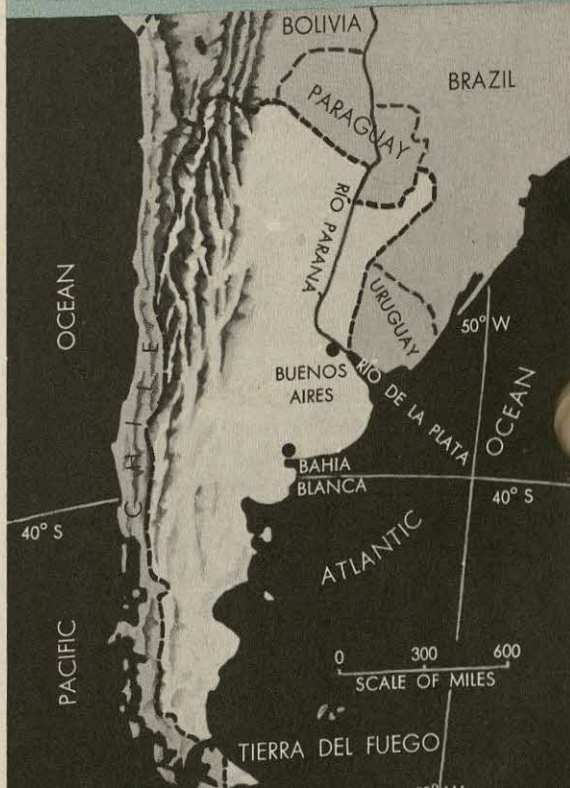
Excepting only New York, the capital city of Buenos Aires is the greatest seaport of the Americas. In the whole Western Hemisphere, only New York and Mexico City are larger cities. Argentina is South America's top commercial nation. Argentina supplies most of the extract for tanning the world's leather—the tannin that comes from the quebracho trees of its northern river-valley forests.

Its Place in South America. Argentina's 1,078,769 square miles make it only about one third the size of the United States. Yet it is so long from north to south, nearly 2,300 miles, that it could stretch from Cuba to the center of Hudson Bay. Its east-west width varies from over 900 miles in the north to some 200 miles in the south.

The South Atlantic Ocean, bordering the country on the southeast, gives Argentina

LAND OF THE PAMPA

Long and narrow Argentina has a hot, tropical north-land and a bitterly cold southern tip. Buenos Aires is about as far south of the equator as Memphis, Tenn., is north of it. The vast plain called the Pampa extends inland from the coast to the western mountains.



nearly 1,600 miles of coastline. To the northeast are Uruguay and Brazil; to the north, Paraguay and Bolivia. On the west, the lofty Andes Mountains separate Argentina from Chile, near whose border rises snow-crowned Aconcagua, the Americas' loftiest peak, some 23,000 feet high.

The Land. From these mountains, the land slopes gradually eastward. In the center of the country it levels off to form the *Pampa*, a vast, flat, and nearly treeless plain, on which the country's famous farms and ranches are located, its greatest cities stand, and most of its people live.

South of this is a larger, much colder, drier, and higher plain, called *Patagonia*. A windswept, dusty region, covered with low, desert shrubs and bunch grass, this area is used chiefly for grazing sheep.

The Gran Chaco plain, in North-Central Argentina, also is dry, but it contains good grazing and farming areas, as well as important forests. Although most of the Northwest is an arid or semiarid grazing region, it has several rich oases, created by the irrigation waters brought down from the Andes by its rivers. *Mesopotamia*, the section between the Paraná and Uruguay rivers, is made up of rolling grasslands and forests, many of which are always swampy.

Rivers. The Colorado and Negro rivers drain Central Argentina. Among the several streams farther south are the Chubut, Deseado, Chico, and Santa Cruz rivers. But the Paraná and Uruguay, with their tributaries and their great estuary, the Rio de la Plata, are far more important. Except for the Amazon in Brazil, they form the largest river system in South America. For information regarding this valuable waterway and its busy ports, see PARANA; RIO DE LA PLATA.

Most of the country's low lakes have no outlets and are surrounded by swamps. But nestling high among the Andes and their foothills are several beautiful bodies of water, which attract vacationists interested in skiing, fishing, and admiring the

great glaciers that reach down from the encircling mountains. Because of its beauty, much of the Andean lake district of Western Patagonia has been set aside as a national-park vacationland.

The Weather. Most of Argentina lies in the Temperate Zone, having a climate similar to that of Central United States. It is, however, enough milder that livestock, harvests, and machinery require no winter shelter. The southern tip of the country lies in the Frigid Zone and is always cold, while the northern areas reach into the Tropics, where summers are very hot and winters are mild.

Rainfall is ample for farming on the Pampa, but generally scarce in Patagonia and the Northwest. It is heaviest in the Northeast, where it comes down in such torrents during the winter that the river valleys remain swampy the year round.

Because Argentina is south of the equator, its seasons are exactly opposite from those of the United States. Thus Christmas comes in summertime, and June, July, and August are the winter months.

Farming and Ranching. Even today, about half of the Pampa has never been plowed. Although the days when Argentina's gauchos, or cowboys, rode the unfenced range are past, its *estancieros*, or ranchers, still use vast stretches of tall native grass to graze the fine beef cattle, sheep, and high-bred horses for which the country is world-famed. Also raised are mules, asses, goats, some hogs, and even some oxen.

Nevertheless, Argentina also produces large quantities of alfalfa for fattening its cattle and enormous supplies of wheat and corn for export. Other important crops include oats, barley, rye, potatoes, and the flax which gives the world most of its linseed. Vegetables, fruits, and dairy products are valuable sources of income near the cities. In the Gran Chaco, cotton, tobacco, and yerba maté, or Paraguayan tea, are important crops. Sugar cane and wine grapes are the chief products of the irrigated northwestern oases, but alfalfa,

citrus fruits, olives, and other fruits also are grown. Other farm products include rice, peanuts, and sunflower seeds, raised for vegetable oil.

Industries. Since wood and coal are scarce, it is unfortunate that Argentina's many waterfalls are so far from its cities that they have never been harnessed to produce hydroelectricity. Nevertheless, its industrial development has been rapid since the late 1930's. The refrigerating of meats for export, the leading industry, is state-controlled and is centered in Buenos Aires, which has the world's largest refrigerating plant. Other industries include flour-milling, quebracho-extracting, tanning, meat-canning and -packing, oil- and sugar-refining, cotton-ginning, and the manufacture of textiles, shoes, clothing, wines, alcohol, cement, and vegetable oils. The country's greatest industrial center is Buenos Aires and its suburbs.

Mining remains relatively unimportant. Nevertheless, valuable amounts of gold, silver, copper, tin, lead, columbium, beryllium, and tungsten are produced. From Patagonia and the Northwest also come considerable quantities of oil and natural gas. Other minerals found include uranium-bearing ores, limestone, and small supplies of iron ore.

Transportation. Argentina's railway system, including lines crossing the Andes, is the largest in South America. Over 26,000 miles long, it has Buenos Aires for its hub. Both the merchant marine and the country's busy river fleets also are enormously important. An extensive highway system includes Argentina's part of the Pan-American Highway, completed in 1942, and a tunnel through the Andes, opened in 1940. Aviation, both domestic and foreign, is highly developed. The country's transportation system, including its railroads, commercial fleets, and domestic airlines, are state-owned, as are its telegraph, telephone, and banking systems.

The People. Most Argentines are native-born whites of European, particularly Spanish or Italian, stock, and many of

them are descendants of the settlers who flocked into the country after 1850. Argentina has few Indians, Negroes, or *mestizos*, over 97 per cent of its people being whites. The total population is about 20,250,000, of whom about one sixth live in Buenos Aires and its suburbs, where they proudly call themselves *porteños*, or *people of the port*. Less than 40 per cent of all Argentines are rural dwellers. In fact, its eight cities of 100,000 or more inhabitants have more residents than all the rest of the country. Spanish is the official language; Roman Catholicism is the leading and state-supported religion.

Education. Primary education is free, secular, and compulsory for children between the ages of six and fourteen. Although illiteracy is high in the rural areas, where school laws are not well enforced, it is lower in Argentina than in any other South American country. High schools are few in number, but Argentina has the best university system in all Latin America, maintaining six national universities. The one at Buenos Aires has as many students as some of the largest universities of the United States. The one at Córdoba, founded in 1613, is one of the oldest in the Americas.

Government. Argentina's President and Vice-President must be native-born Argentines and Roman Catholics. Elected by direct, popular vote for six years, they may be re-elected. Members of the two-house national legislature also are elected for six years. In "emergencies," the President may intervene in the local affairs of the country's sixteen provinces, seven territories, and one federal district. Voting is compulsory, and women have had the ballot since 1947. The present constitution was adopted in 1949.

History. The first white man to see the Argentine was the Spanish explorer, Juan Diaz de Solis, who discovered the Plata in 1516. But the real settlement of the Spanish colony did not begin until Buenos Aires was permanently established by Juan de Garay in 1580.



FOUNTAINS PLAY IN A SUNNY SQUARE IN BUENOS AIRES

Pan American-Grace Airways

A bustling, modern metropolis, the Argentine capital ranks among the ten largest cities in the world.

After successfully resisting two attempted British invasions in 1806-7, the colonists began to talk of home rule, then, in 1816, declared their independence from Spain. Nevertheless, the development of both the Pampa and Buenos Aires lagged until about 1850, when refrigerated ships, railways, barbed wire, windmills, and imported beef cattle began to bring the changes that have made Argentina what it is today. The long civil war and years of disturbances that followed the establishment of the republic were finally ended by the dictator Manuel de Rosas, who succeeded in unifying the nation in 1852. In the following year, the country adopted a constitution modeled after that of the United States, and established a stable government.

In 1902, after a long boundary dispute with Chile had been peacefully settled, the great monument "Christ of the Andes" was set up on the Argentine-Chilean bor-

der as a symbol of peace between the two nations. Argentina remained neutral during World War I and most of World War II, when its sympathies were pro-Axis. In 1945, however, it declared war on Germany and Japan and joined the United Nations.

In 1946 Juan Peron made himself dictator. He built up a strong labor movement, but suppressed the liberties of the people, ran the country into debt, and quarreled with church leaders. In 1955 his opponents forced him into exile. Major General Pedro restored the old constitution, and property that had been expropriated. In the free election held in 1958, Dr. Arturo Frondizi was elected President. Dr. Frondizi stabilized the currency, and encouraged foreign investment.

Also consult the following articles:

Andes
Buenos Aires
Magellan, Strait of

Patagonia
Tierra del Fuego
Uruguay



LAND OF NEVER-ENDING DROUGHT

This is a scene in the "Great American Desert," an arid region in the Southwestern United States.

ARGON. So rare and so inactive is the gas, argon, that it was not discovered until 1894. Argon closely resembles nitrogen, which forms seventy-nine per cent of the atmosphere, but it is somewhat heavier than nitrogen and, so far as scientists have been able to learn, it will not unite chemically with any other element. It is used in our incandescent lamps. Argon forms less than one per cent of our air.

ARGONAUTS, *ahr'go nawts*. Long before the Trojan War, according to Greek mythology, a band of Greek heroes sailed the perilous seas of the ancient world in search of the mythical Golden Fleece. Because their boat was named the *Argo*, these adventurers were called Argonauts.

Aeson, king of Thessaly, had tired of ruling and gave the crown to his brother, Pelias, on the condition that he should rule only until Jason, the son of Aeson, reached manhood. When Jason came of age, Pelias pretended to give the crown back as he had promised, but suggested that Jason and his companions could become famous by first going in search of the Golden Fleece, said to be in the distant land of Colchis, on the Black Sea.

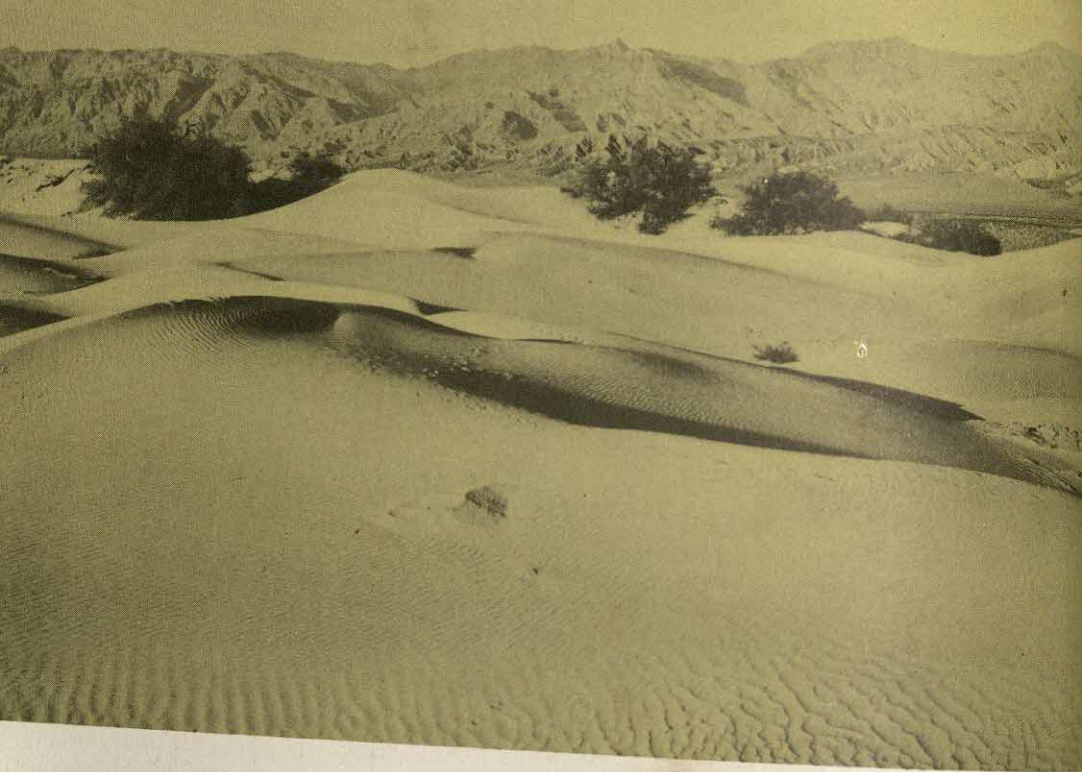
Jason and his five companions, Orpheus, Theseus, Castor and Pollux, and Hercules, accepted this suggestion and set forth in the ship *Argo*. Adventure followed ad-

venture until they reached Colchis. There they learned that the Golden Fleece hung from the branches of a tree and was guarded by a dragon that never slept, night or day. Medea, daughter of the king of Colchis, came to the aid of the Argonauts. Using her magic power, she made the dragon fall into a deep sleep. Jason then secured the Golden Fleece and departed for home, carrying Medea with him. See JASON.

ARID REGION. Many thousands of square miles of the earth's surface do not have enough rain to grow crops. In these arid regions, as they are called, man cannot live for any length of time, unless he brings water to the soil by mechanical means, or conserves moisture in the soil by a process called dry farming.

The great deserts of the world, like the Sahara, are arid regions, with little or no rainfall, but they contain hundreds of square miles of land which need only water to support abundant vegetation.

These arid regions have just enough moisture during the year to grow grass. Huge areas like this in Africa and Asia provide pasture lands for wandering tribes of nomads, who go about with their flocks, stopping wherever there is enough grass to feed the animals. When it does rain in such places, plants and grasses



Union Pacific Railroad Photo

SAND DUNES IN ARID DEATH VALLEY

Terrible heat scorches the barren floor of Death Valley, the bed of an ancient salt lake, shut off by mountains from moisture-bearing winds from the sea.

grow very fast, showing that, if rivers could be steered across these lands, they could be made to support great populations.

In the southwestern part of the United States, farmers have done just that. Much of what was once known as the "Great American Desert" has been turned into extremely fertile farm land, and is not only supporting its own population, but providing food for the rest of the nation. This process of bringing water to arid regions is called irrigation. In the West, from Arizona north to Montana, there is a great belt where dry farming is practiced.

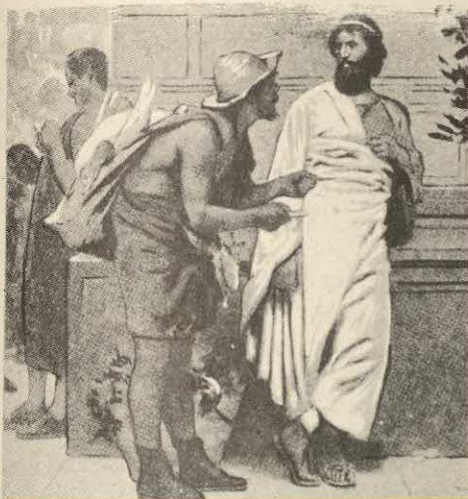
An arid region is an area which has less than twenty inches of rain a year. If it has less than ten inches, it is a desert. By contrast, fertile regions in the Central United States have between thirty-five and forty inches of rain a year.

Occasionally, a fertile region becomes so

parched by drought, or successive droughts, that it reverts to an arid condition. Undoubtedly, many arid regions were once fruitful areas. During the three years from 1934 to 1936, the west-central parts of the United States had a protracted drought. The dryness was accompanied by "dust-storms"—great clouds of dirt carried along by the wind. The earth of plowed fields became so dry that it was carried off in the air and blown great distances. Crops in this so-called "Dust Bowl" were ruined, and large numbers of farmers and their families had to move to more fertile regions or starve.

The reclamation of such areas and the prevention of drought devastation have been—and are—primary goals of conservationists in the United States. See IRRIGATION; DRY FARMING.

ARISTIDES, *air is ti'deez* (about 530-467 B. C.). This famous soldier and statesman of early Greece was so unselfishly



THE ILLITERATE'S REQUEST

Aristides is asked to mark a ballot sending himself into exile.

patriotic that he fought for his native land after being exiled from it. During the Persian Wars, his judgment in having Miltiades made chief commandant of the Athenian army was largely responsible for the defeat of the Persians at Marathon (490 B. C.). Before, leadership had been entrusted to one of ten generals, and was changed daily. The people then elected Aristides archon, or chief magistrate, of Athens, but his jealous rival, Themistocles, forced his exile in 483 B. C., saying that he was dangerous to the democracy.

It is said that, when the people voted on sending him from the country, Aristides even wrote his own name for an illiterate whose only reason for wanting Aristides exiled was that he was tired of hearing him referred to as *The Just*.

Shortly afterward, Persia began the invasion of Greece, and, although in exile, Aristides tried to unite the Grecian cities. Before the Battle of Salamis, he offered his support to his rival, Themistocles, and planned the method of attack. Resuming his former place in Athenian affairs, Aristides helped to organize the Delian League, as a safeguard against Persian aggression. A pauper at his death, he was buried by the nation, and his children were

given money and lands by the people. See **ATHENS**.

ARISTOCRACY, *ar is tok'ra sie*. When a few wealthy or high-born persons rule a country, the government is called an *aristocracy*. Actually, this form of control is an *oligarchy*, or government of the few.

Aristocracy originally meant administration by the best people, in contrast to rule by the mob. However, because aristocratic governments have frequently degenerated into other forms of administration, the word has come to have more of a social than political meaning. From the ascent of George I to the throne of England in 1714 to the end of the eighteenth century, that country was under aristocratic rule. Today, the word aristocracy is also used in the sense of *finest*, as in the phrase, aristocracy of appearance.

ARISTOPHANES, *ar is tof' a neez* (444-380 B. C.). The fame of this poet of ancient Greece rests upon his comedies written in verse. They treated of political subjects, and held up to ridicule some of the most prominent men of ancient Greece.

Aristophanes was born in Athens. He first appeared as a poet in 427 B. C. At one time he had made sneering and sarcastic remarks about Cleon, who was at that time a very popular and powerful leader in Athens. In return, Cleon accused the poet of unlawfully becoming an Athenian citizen. Aristophanes secured revenge for this untruth by his comedy *The Knights*, in which he himself took the part of Cleon. His other important dramas are *The Clouds*, in which the great philosopher Socrates is ridiculed; *The Frogs*, a satire on the Greek poet Euripides; *The Wasps*, and *The Birds*.

ARISTOT'LE (384-322 B. C.). Pupil of Plato, teacher of Alexander the Great, master of the Lyceum, or college of Greek thinkers, Aristotle was the greatest philosopher of antiquity and one of the greatest thinkers of all time. He gave order and method to the whole world of knowledge, and his influence on succeeding ages prob-

ably outweighs that of any other scientist or philosopher.

The Pupil of Plato. Aristotle was born in Stagira, a Greek colony on the Aegean Sea. His father was court physician to Amyntas II, king of Macedon, whose grandson was Alexander the Great. After his father's death, Aristotle was placed in charge of a family friend, who directed the youth's education until he was about eighteen. Aristotle then determined to go to Athens to seek out Plato, the renowned disciple of Socrates.

When Aristotle arrived at Athens, he found that Plato had gone to Sicily and would be absent for three years. But he was determined to stay, for Athens was the center of the philosophy and the art of the ancient world, and great was its appeal to the inquiring mind of the young man. He filled in his time studying rhetoric, and on Plato's return became the most brilliant student in the great master's school of philosophy. Plato realized the promise of his pupil and is said to have called him "the intellect of the school." During his twenty years' stay with Plato, Aristotle acquired a mastery of reasoning that led him to refute some of the doctrines of Plato himself.

Tutor of Alexander. After Plato's death, in 347 B. C., Aristotle spent some time in Asia Minor with his friend Hermias, whose sister he married. Then he was called to Macedon as teacher of Prince Alexander, the thirteen-year-old son of Philip of Macedon. After Alexander became king, he gave his former tutor great sums for scientific research, and he took with him, on his march through the Persian Empire, a large number of men who devoted themselves to collecting specimens of plants and animals. These were sent to Aristotle for classification. Alexander's respect for the learning and culture of Greece was due in part to the influence of his famous teacher.

Teacher of Philosophy. Aristotle spent three years with Alexander, and then returned to Athens to establish a school in

the Lyceum, a gymnasium in the suburbs. Here he gathered about him a large circle of pupils. It was his custom when lecturing or teaching to walk up and down the *peripatos*, a promenade at the school, and from this Aristotle's organization came to be known as the *Peripatetic School of Philosophy*. He remained here until Alexander's death in 323 B.C. At that time many of the Greeks believed that because of his former association with Alexander, he was out of sympathy with Greek aspirations for freedom. Fearful of his life, Aristotle fled to Chalcis, on the island of Euboea, east of Athens, where he died.

His Contribution to World Thought.

In his attitude toward learning, Aristotle was a firm believer in the realities of life. He studied life's mysteries with a view to acquiring more facts, which in turn would lead to greater knowledge. He was the creator of natural science, because he approached the study of natural phenomena with a scientific mind that saw the importance of organization and logical arrangement. He urged his pupils to examine, compare, classify.

As a philosopher, Aristotle was chiefly interested in the substance of things. In this sense he differed from Plato. That philosopher believed that the great task of thinking men was to improve life. Aristotle would first know more of life, meanwhile accepting it for what it was.

Aristotle defined and classified the various branches of knowledge, such as physics, metaphysics, psychology, ethics, politics, rhetoric, poetics, and logic. By so doing he laid the foundation of all the sciences and philosophies of today. One of his methods of reasoning has come down to us exactly as he devised it; namely, the *sylogism*, in which a conclusion is reached from two previous statements.

Of Aristotle's writings that have come down to us, the most important are *Logic*, *Rhetoric*, *Poetics*, *Physics*, *Metaphysics*, *Ethics*, *Psychology*, *Politics*, *History of Animals*, and *Meteorology*. See PHILOSOPHY; PLATO; ALEXANDER THE GREAT.



Standard Oil Co. (N. J.); Ford Times

ARITHMETIC: FRIEND OF BIG BUSINESS — A PROBLEM TO THE SCHOOLBOY

ARITHMETIC, a *rith' me tik*. We owe a debt of gratitude to the Arabs and Hindus of 5,000 years ago, because they devised their system of numbering and counting. These Oriental peoples actually forged the most useful everyday tool of modern civilization—one tool we cannot get along without—arithmetic.

The World Depends on Numbers. If everybody suddenly lost the power to count and to use numbers, all business and industry would be paralyzed. A great hush would fall upon the world. Telephones would cease to ring. Money would be worthless—no one would know what it meant—and cash registers would be silent. Important letters would never arrive at their destinations, for railroads, airplanes, motor cars, and ships would stop running. Calendars and clocks would go to the junk pile, for they would no longer "make sense." Our entire system of international trade would have to be discarded, and people would go back to bartering and trying to count on their fingers and toes.

Arithmetic, the accurate, practical science of numbers, is the one tool which every per-

son must have, in order to adjust himself to modern living. It is not a subject to be studied for a few years, then forgotten. It is almost as necessary, every day, as food and air and clothing. Farmers, bankers, doctors, engineers, baseball players, housewives, in fact, everyone, no matter what his daily work is, uses his knowledge of arithmetic.

Naming the Numbers. Because some system of arithmetic, or of numbering, is essential to any kind of civilization, man began to develop primitive methods of counting thousands of years ago. Before the invention of numbers, many different methods were used. A sheep herder, for example, would give each one of his sheep a name. Then, when he wished to see if he had lost any, he had to go through the laborious work of calling all of them off by name. Even when the Greeks began to use numbers, they named them after the letters of their alphabet. The Greeks were not alone in devising this system; the Romans and Hindus did the same thing.

We still use Roman numerals for designating certain dates, as one can see by look-

ing at the cornerstone of a building or reading about Henry VIII or Louis XIV. However, this is getting ahead of the story, and we must dig back into the centuries before the Greeks and Romans to see how counting and numbering really originated.

From Fingers and Toes to Calendars.

When man first began to count he did not use number *names*, as we do today, but *counters*. Probably the first counters that man used were his fingers. With them, he learned to count to ten. Sometimes he would use both his fingers and toes and arrive at the imposing count of twenty! It is doubtful just which people actually were the first to use arithmetic, but four countries, Egypt, Mesopotamia, India, and China, share the honor. As early as 3000 B. C., Egyptian architects were building great pyramids and constructing perfect right angles. We know, too, that they had a calendar of twelve months. Each month was made up of thirty days, and five feast days were added to make up the year. Both of these ambitious undertakings, the calendar and the construction of the pyramids, show that the Egyptians had to have a good knowledge of mathematics.

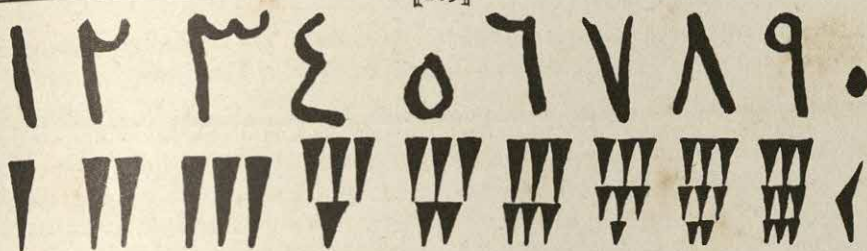
The inhabitants of Mesopotamia—the Chaldeans, Babylonians, and Assyrians—had a well-developed system of numbering. Many of the tablets of brick and clay upon which they made their marks or numbers have been found and deciphered. Scientists who can read these strange markings say that the merchants of Mesopotamia had regular systems of accounts, measures, bills, and even a calendar.

Arabic Numerals. In India, the priests were among the first to learn numbers. In the early days their numbers went only to four. They counted one, two, three, many. The term "many" was used for everything greater than three. They later developed some skill in mathematics. In fact, the figures which are still used, the Arabic, are really East Indian. They were probably brought by traders from India to Baghdad. Europe learned of them through a book which was written at Baghdad by

Mohammed, an astronomer, to the caliph of Baghdad. The book explained the Hindu method of figuring, and since it was written in an Arab country, the numbering system that it explained was known as Arabic. Historical records also show that a system of numbering similar to that used in Egypt and Babylon was used in China. The Chinese also developed a decimal system, and tradition has it that they also used a scale based on sixty, the same kind of scale upon which the divisions of our hour are based.

Roman Numerals. Even after man had learned to use numbers, he had a great deal of difficulty in doing even the simplest problems. There were a number of reasons for this. The unhandy system of writing numbers which the Greeks and Romans used was one of the difficulties. In their system, each number was a letter. The number 28, for example, would be written XXVIII. Can you imagine how much time it would take to write lengthy numbers? To get out of the work of writing all the numbers down, someone invented a machine to do addition and subtraction rapidly. It was called an abacus, and was a little frame of wood on which were wires strung with buttons or beads. To add or subtract, all that was necessary was to move the button up and down. This little instrument is still used by many people in China, Russia, and Japan; you can see one when you tour an American "Chinatown."

The Origin of Zero. The other great obstacle to the solving of arithmetic problems was the fact that the Greeks and Romans had no zero. Some historians explain this by saying that the Greeks and Romans did not use a zero because they refused to consider *nothing*, which is what zero would have been. However, when Arabic numbers were introduced to Europe, the zero was also brought in. The Arabs called the zero *sifr*, meaning *empty*. In Latin it became *cifra*, and from this we get the word *cipher*. Later, the word came to mean any number, and it was also used



STRANGE BEGINNINGS OF OUR MODERN NUMBERS

Above are Arab symbols for numbers from 1 to 10. Babylonian numbers are shown below as a verb, "to cipher," meaning to calculate. To avoid unnecessary confusion, the Italian word zero was introduced.

Modern Machines. The first adding machine ever used was probably the abacus. Modern man has invented machines far superior to this tool. Calculating machines solve all kinds of number problems with very great speed. Most of these machines are very simple to operate. All that is necessary is to push down certain keys which represent numbers and pull a lever; the correct answer appears printed on a roll of paper. These machines are so accurate that they cannot make a mistake.

Scope and Methods. Almost all of the problems which we must solve in everyday life involve numbers of pounds, yards, gallons, or dollars. Such numbers are called *denominate*. Before we can solve such problems we must learn to figure with numbers which are called *abstract*. The simplest kind of abstract numbers are *digits*, the numbers from one to nine inclusive. When two or more digits are combined, as in the numbers 29 and 375, they are called *integers*. Both digits and integers are whole numbers. Arithmetic makes use of another kind of number called *fractions*. Fractions are not whole numbers, but represent parts of a number.

The first step in learning arithmetic is made when a child is taught the digits. He may learn these in any one of a number of ways. In some cases he is taught to associate them with the numbers of his fingers or with blocks. Numbers greater than nine and ten he must memorize in their proper order. In a short time he understands just what quantity each num-

ber represents. When he has learned to count accurately and rapidly, he is ready for the next step.

Addition. The operation of addition as it is performed today is very similar to that which the Romans employed. The main difference or advantage of our present system is the greater ease and rapidity with which the Arabic numbers can be written. Here is an example of how a Roman boy would write a problem in addition, and how an American lad would solve the same problem:

Roman	Modern
V II	7
X V III	18
XX V	25

or $7 + 18 = 25$

The symbol used for addition is $+$. The result of the problem, in this case 25, is called the *sum*. Problems in addition may be solved only when the denominations of the numbers are the same. In other words, it is not possible to add feet and inches, pints and quarts, dimes and quarters, or any numbers of unlike denominations. Before such problems can be solved, the denominations must be made the same.

In a problem where it is required to add 3 feet and 6 inches, either the feet must be changed to inches or the inches to feet. Since there are 12 inches to a foot, there will be 36 inches in three feet. The problem then is 36 inches plus 6 inches. $36 + 6 = 42$, number of inches. If it is necessary to express the answer in number of feet rather than inches, the sum, 42 inches, should be divided by the number of inches in one foot. The answer $3\frac{1}{2}$ is the number of feet contained in 42 inches.

In adding dimes and quarters, the answer is expressed in cents or dollars; 3 quarters plus 4 dimes equal one dollar and fifteen cents.

Subtraction. The next operation that one learns in arithmetic is that of subtraction. In subtraction, one quantity is diminished or made smaller. The number to be diminished is the *minuend*. The number by which it is to be diminished is called the *subtrahend*. In the simple problem $29 - 13$, 29 is the minuend, 13 the subtrahend. The result, which in this case is 16, is called the *difference* or *remainder*. This problem would be written in this manner:

$$\begin{array}{r} 29 - 13 = 16 \quad \text{or} \quad \begin{array}{l} 29 \text{ minuend} \\ - 13 \text{ subtrahend} \\ \hline 16 \text{ difference} \end{array} \end{array}$$

To check or prove the answer to a problem in subtraction, the subtrahend and the difference are added. If the sum of these two equals the minuend, the problem has been correctly solved.

Multiplication. In multiplication, the object is to increase a given number a certain number of times. The symbol for this operation is \times . In the problem 3×5 , the object is to increase the number five, three times. Five is called the *multiplier*, three is the *multiplier*, and the result, in this problem 15, is the *product*. Multiplication is really no more than the addition of one number to itself a certain specified number of times. Thus, $5 + 5 + 5 = 15$. In order to speed up the process of multiplication, children are taught multiplication tables which take in all the numbers from one to twelve. Tables of higher numbers have been prepared so that it is possible to find the answers to many problems without actually multiplying the numbers out. In cases of larger numbers, the form generally used is this:

$$\begin{array}{r} 333 \times 79 = 26 \ 307 \quad \text{or} \quad \begin{array}{r} 333 \\ 79 \\ \hline 2997 \\ 3331 \\ \hline 26307 \end{array} \end{array}$$

Division. The process of division solves the number of times one number is contained in another. In the problem $100 \div 10$, 100 is called the *dividend*, 10 the *divisor*. The result is the *quotient*. Two types of division are taught, long and short. Short division is used for small numbers, or when the divisor is a digit. Long division is employed for larger numbers.

Fractions. After the student has learned to solve problems with whole numbers, he is introduced to fractions. First he learns that there are two kinds of fractions—*proper* and *improper*. Proper fractions, like $1/3$, $2/5$, include all fractions where the *numerator*, that is, the number to the left or on top of the line, is smaller than the *denominator*, the number below or to the right of the line. Improper fractions are those in which the numerator is larger than the denominator, such as $6/5$, $7/4$. Before it is possible to add fractions, each must have the same denominator. Thus $2/10$, $3/10$, and $5/10$ may be added without any difficulty. All that is necessary is to add the numerators. The answer will be $10/10$.

If the denominators are not the same, they must all be changed to a common denominator. To add $1/4$ and $1/6$, a common denominator must be found; that is, a denominator into which 4 and 6 can be divided evenly, such as 12. $1/4$ becomes $3/12$, $1/6$ becomes $2/12$. The two can then be added. The answer will be $5/12$. In subtraction the fractions must also have the same denominator, but in multiplication no change is necessary. Division of fractions is performed by inverting the divisor and then multiplying. $3/5 \div 1/2 = 3/5 \times 2/1 = 6/5$ or 1 and $1/5$.

Decimals. See PERCENTAGE. For additional information consult:

Circle	Interest
Cube Root	Longitude and Time
Cubic Measure	Measurements
Cylinder	Metric System
Discount	Power
International Date Line	Standard Time

DESERT SUNSET

Arizona, the Grand Canyon State, is noted for its scenic beauty and dry, sunny climate. Its state flower is the blossom of the saguaro, a giant cactus of the southern Arizona desert.

Santa Fe Railway



ARIZONA. Represented by the forty-eighth star in the flag, Arizona did not enter the Union until 1912. Yet no part of the United States suggests more strikingly the old and the prehistoric than does this youthful state. Within its borders is one of Mother Earth's most spectacular natural wonders, the Grand Canyon of the Colorado, cut by the slow action of the river through unnumbered ages. Here, too, is the Painted Desert, colorful and mysterious; and the Petrified Forest, with its fallen trees hardened into stone. The huge, ridge-rimmed depression called Crater Mound was made ages ago — by a gigantic meteorite, some believe; by a volcanic-steam explosion, others say.

In Arizona, students of old civilizations find ruins of cliff dwellings, built by an ancient people on high plateaus or on steep rocks. The Pueblo Indians, living today in their stone and adobe houses, may be descendants of this strange race.

The new and the old are side by side in Arizona. To this land of small rainfall, man has brought water for crops, as well as electrical power, by building huge dams. The mines and smoking smelters of the largest copper industry in the entire United States tell of the vanishing frontier of the cowboy. Steeped in the lore of the past and of the early Spanish explorers,

fascinating in its physical features, Arizona is making a place for itself among the mining and agricultural states of the Union.

Its Location and Size. Arizona lies on the Mexican border between New Mexico on the east and California and Nevada on the west. Utah bounds it on the north, and on the northeast it touches a corner of Colorado. The Colorado River, so valuable for irrigation and electricity, separates the state from California and Nevada.

Arizona is the sixth largest state in the Union, with an area of 113,909 square miles. Ranking next in area among the states is the neighboring state of Nevada, with an area of 110,540 square miles.

Desert, Mountain, and Plateau. The state may be divided roughly into three sections of approximately equal area: (1) the southwestern section, characterized by broad desert valleys with scattered mountain ranges and isolated peaks; (2) the central section, a broad belt of parallel mountain ranges with narrow valleys, which includes the so-called Mogollon Rim, extending from southeast to northwest; and (3) the northeastern section, a high plateau. At Yuma the altitude is about ninety feet above sea level, but the northeastern plateau and other extensive



Courtesy Arizona Highway

RAINBOW BRIDGE A GIGANTIC ARCH

designed by Nature, connecting two peaks over a canyon.

The Navajo expert (left) produces beautiful silver ornaments, while his dark-skinned daughter looks on in admiration.

mountainous areas lie a mile or more higher. Several mountain peaks reach or exceed 10,000 feet, Humphrey's, or San Francisco, Peak rising 12,611 feet.

Arizona's Changing Rivers. All of Arizona with the exception of a few square miles bordering Mexico is drained by the Colorado River. The other important rivers, the Little Colorado and the Gila, are its tributaries. The smaller streams, except the Bill Williams, drain into these. Most of the rivers of Arizona are nearly always dry, but occasionally they become torrents in an incredibly short time. Automobiles have been washed away while traveling short stretches of roads lying in dry river beds. The largest irrigation projects depend upon the control of these torrential streams. The Salt River, for example, is regulated by a series of dams.

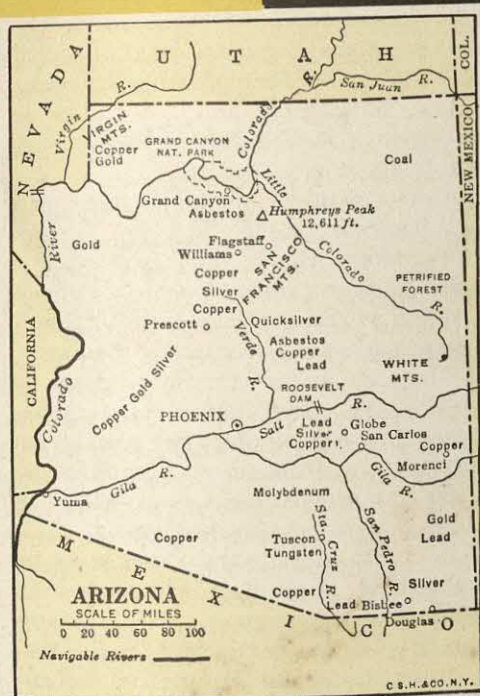
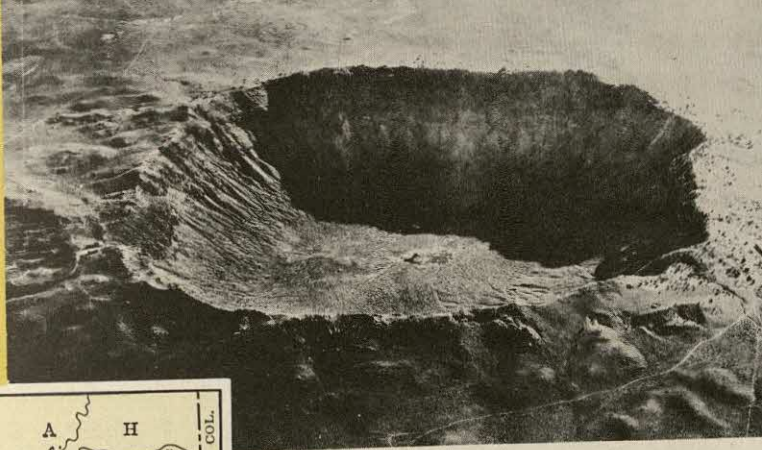
In some cases, notably the Santa Cruz, what is known as a river and its tributaries might better be considered a series

of rivers flowing one into the other. There is a continuous channel, but floods in the upper tributaries often do not reach the main channel beyond the mouth of the last tributary. Fortunately, these floods sink away into the underground reservoir, for water may often be stored beneath the ground and drawn upon with pumps where needed, with less loss than it can be stored in mountain reservoirs and carried down by canals to the farms in the valleys. Much power is developed at the dams in, or on the border of, Arizona and is distributed for municipal and industrial use and for running irrigation pumps.

The Varying Climate. The outstanding feature of climate in Arizona is variety. This is due primarily to the great differences in altitude. The low desert valleys of the southern part are semi-arid and subtropical, while the higher mountains and the northern plateau are never excessively warm and often quite cold. Maximum temperatures during June and July range from 120°F. at Yumá to 85°F. at Flagstaff. Owing to the low humidity, temperatures of 110° to 115°F. are not so

CALLING CARD

Meteor Crater in northern Arizona is a great gash in the earth that some people believe was caused by a huge meteor from outer space. It is 4,000 feet in diameter and about 600 feet deep.



oppressive as 90° to 100°F. in humid states. Sunstroke is uncommon. The daily range of temperature under the clear skies of the almost rainless months is 30° to 60°F. Cold nights come as a welcome relief after intensely hot days. In the higher altitudes the growing season is short because of late spring and early fall frosts, but at lower altitudes, in which nearly all the irrigated districts lie, severe freezes seldom occur. Winter minimum temperatures vary from just below freezing in the lower Colorado Valley to 15° or more below zero in the north.

The rainfall for the state is light, the average for twenty-two years being 13.33

inches, and varies from two inches in the southwest to twenty inches in the north-central part. The summer rainy season begins about July 1 and lasts until the middle of September. The precipitation during this period is often torrential, and falls in almost daily local showers of short duration and relatively small area.

Over eighty per cent of the total possible sunshine is received, and few days during the year are without sunshine. This condition, with the equable winter climate, makes Arizona a Mecca for tourists, especially those searching for comfortable outdoor life all the year around. Destructive winds seldom occur and are not of the tornado variety.

Resources of the Land. The mesas and foothills of the state are characterized by shrubs and scrub trees rather than forests. Great areas are covered more or less densely with creosote bush (greasewood), saltbushes, cacti, ocotillo, yucca, palo verde, mesquite, and similar plants. From altitudes of 4,500 to 5,000 feet, scrub oaks and junipers predominate up to 5,800 or 6,000 feet, where the true forests of pine and spruce begin. The largest known forest of the variety of yellow pine classed as *Pinus scopulorum* is in Arizona, and is crossed by the Santa Fe Railroad between Ashfork and Canyon Diablo, a distance of about seventy miles.

Mining is the leading industry of the state. Copper, its most valuable metal, is mined and processed in huge amounts.

Also important are gold, silver, lead, zinc, tungsten, manganese, vanadium, asbestos, mercury, barite, fluor spar, and helium, discovered in Arizona in 1950.

Other valuable minerals include clays, limestone, cement materials, onyx, and marbles. Turquoise, malachite, opals, and garnets are only a few of the gems found there. The state also has billions of tons of coal, but most of it is on Indian reservations, where Federal regulations prevent mining of this fuel.

A Vacationland. Arizona's dry, warm, invigorating air, brilliant sunshine, and hot mineral springs are among its other chief resources. Besides attracting many health-seekers, they lure a steady stream of vacationists to the state every year, especially during the winter. Also helping to make catering to visitors a major industry are Arizona's fine desert and mountain scenery, wild-game hunting, and long, colorful history. Among its scenic and historic wonders are Grand Canyon National Park and sixteen national monuments. Its prehistoric cliff dwellings and centuries-old Spanish missions are popular attractions. Its rodeos, "dude ranches," such as those around Wickenburg, and old mining camps, such as Tombstone, are reminders of the days when cowboys rode the range and gun-toting desperadoes terrorized the Western frontier. Its Indian villages, reservations, and ceremonials link the present with the shadowy past. Small wonder that scenic, history-rich Arizona is one of the nation's most popular vacationlands.

Crops and Livestock. The inventive genius of man is strikingly shown in Arizona, where irrigation and dry farming have turned once-arid, useless acres into fertile farms, ranches, orchards, and truck gardens. Although Arizona's Indians irrigated their fields centuries ago, all huge dams and lakes that have made this transformation possible have been built in this century, most of them by the Federal Government.

The oldest of these great irrigation proj-

ects utilizes the waters of the Snake River and consists of a series of dams and reservoirs, including Roosevelt Dam, in use since 1911. Other dams wholly within the state include the Coolidge, on the Gila, and the Bartlett, on the Verde. In the bordering Colorado River is Hoover (formerly Boulder) Dam, the world's tallest man-made water barrier, whose reservoir, Lake Mead, is the largest artificial lake on earth. Other dams across the Colorado are the Laguna, Parker, Imperial, and Davis. Besides producing hydroelectricity, these great projects provide the irrigation water that has made agriculture a leading Arizona industry.

Cotton, mostly of the long-staple variety and the most valuable field crop, is raised in the south. Alfalfa, yielding as much as eight cuttings a year, is extensively grown. Other field crops include grain sorghums, wheat, barley, oats, and corn for forage.

The state is, however, more noted for its fruits and its winter and early spring vegetables. Among these are high-quality grapes, citrus fruits, dates, figs, olives, lettuce, and melons, carloads of which are shipped to outside markets yearly.

But, despite the rapid increase in the number of acres that have been made productive by irrigation and dry farming, by far the largest part of the state remains unsuited to farming and orcharding. Nevertheless, vast stretches of its less-favored areas are covered with native grasses, on which range cattle are grazed. Some of these are sold for beef; many, to feeders in California and other Western states.

Arizona's large cattle ranches are found chiefly in the southeast and in its plateau area. Dairying, also important, is centered in the irrigated valleys. The northern and higher ranges support flocks of sheep and goats, producing wool and mohair. About one half of the state's many sheep are owned by its Indians, particularly the Navajos. Horses, mules, hogs, poultry, and honey are other important sources of income.

Manufactures, Arts, and Crafts. Mineral-rich Arizona's leading manufacturing activity is the smelting of its ores. Douglas, for example, is noted for the smelting of the copper and lead that come from nearby Bisbee and its environs, one of America's greatest copper-producing areas. Although other industrial development has only begun, the state has meat-packing and fruit-processing plants, feed and flour mills, sawmills, cotton gins, factories making ice for refrigerating railway cars, and various other industrial plants.

Arizona's Indians have long been famous for their artistic silver and copper jewelry and other handmade metalwares. Among their other outstanding handicrafts are fine pottery, blankets, baskets, beadwork, and leather goods. The state is also noted for the works produced by those making up its artists' and writers' "colonies" at Tucson, Phoenix, and Flagstaff.

Arizonans. The population of Arizona, still one of the most thinly settled of the states, is made up of three main groups. The largest of these is composed of Anglo-Americans, natives of the United States and descendants of English-speaking peoples. Although Arizona had few such settlers before the Gila River gold rush of the late 1850's, their number has steadily increased since then. The Spanish-Americans, the second-largest group of whites, are descended from Arizona's early Mexican and Spanish settlers. Still speaking Spanish and retaining many of their old customs, this group has greatly influenced the culture of the state. A third group is made up of Indians, who are more numerous in Arizona than in other states of the United States. Chief among the several tribes represented are the Navajos, Hopis, and Apaches, many of whom live on the state's fourteen reservations. Among Arizona's few foreign-born residents, Mexicans are most numerous. Its population in 1960 was 1,295,000 — an increase of more than 70 per cent over that of 1950.

Although its people are widely scattered,

Arizona has a well-managed public-school system. The state maintains a university and agricultural school at Tucson, teachers' colleges at Tempe and Flagstaff, and junior colleges at Phoenix and Thatcher. Most of its Indians attend Federally operated schools on their reservations, at Tucson, or at Phoenix. Famous Lowell Observatory, at Flagstaff, was built by the distinguished astronomer Percival Lowell.

Government. Arizona is governed under the progressive constitution it adopted just before joining the Union. As amended since, it provides for the initiative, the referendum, and the recall. The governor and other state officials, including members of the two-house legislature, are elected for two years. Phoenix has been the capital since 1899.

History. Arizona's early history is linked with the Spanish conquerors of Mexico, who tramped into its territory in search of the fabled treasures of the "Seven Cities of Cibola." Among these was Marcos de Niza, Franciscan friar, who became the first white man to enter Arizona in 1539. In the next year, Coronado and his expedition arrived. Yet it was not until 1690 that any real pioneering was begun, by Father Eusebio Kino and other padres who built a chain of missions in Southern Arizona.

Despite Indian uprisings, the Spaniards remained in control of Arizona until 1821, when they lost it to Mexico. By winning the Mexican War, the United States gained all of Arizona north of the Gila in 1848. In 1863 it acquired the southern part by the Gadsden Purchase and made Arizona a territory. After its admission to the Union in 1912, the state developed rapidly, as new mines were opened and power and irrigation projects were completed.

Also consult the following articles:

Apache	Hopi
Cliff Dwellers	Irrigation
Colorado River	Mesa
Coronado, Francisco	Navaho
Dam	Parks, National
Dry Farming	Phoenix
Gadsden Purchase	Pueblo
Grand Canyon	Reclamation



CAPITOL OF THE WONDER STATE

The seat of government at Little Rock.

ARKANSAS, *ahr' kan saw*. A productive soil, great timber resources, rich mines, quarries, and oil wells, and many health-bringing mineral springs make Arkansas one of the favored states of the Union. "The Wonder State," its people have named it, and with reason. No Southern state has greater mineral resources, and none of the other forty-eight states has as many mineral springs. In Arkansas is found the only diamond mine in North America. Pearls are obtained from the mussels in its northern streams. Neither exclusively north nor south, Arkansas has desirable soil and climatic conditions of both sections. Wheat is grown as well as cotton, rice as well as apples. Because of the importance of the apple industry, Arkansas has chosen the apple blossom as the state flower.

Location and Area. Rolling down from the north, the Mississippi River forms the eastern boundary of the state, separating it from Tennessee and Mississippi. To the north lies Missouri; to the west, Oklahoma and Texas; to the south, Louisiana. Its location places Arkansas in the West South-Central group of states. The area of Arkansas is 53,102 square miles, and it is twenty-seventh in size among the states.

The Land and Its Waters. The greater part of the state lies in the immediate basin of the Mississippi and its numerous tributaries, but the northwest corner shares with Missouri the higher land of the Ozark Plateau. Elevations vary greatly. In Southeastern Arkansas are points less than 100 feet above sea level, while in much of the eastern and southern sections elevations may reach 500 feet. In the west-central and northwestern parts are the Ouachita and Ozark mountains, where the average elevation is about 2,000 feet. The highest points, at Mount Magazine and Mount Blue, rise about 2,800 feet above the sea.

About 3,000 miles of navigable rivers lie within the state. In proportion to its size, Arkansas has more miles of waterway than any other state, but there are no lakes except the "ox bows" formed as rivers have cut new channels. Except in the northeastern section, where a portion of the Missouri extends south between the Saint Francis and the Mississippi, the latter river forms the entire eastern border.

The Red River forms part of the boundary between Texas and Arkansas. Cutting the state roughly into two triangles, the Arkansas River enters the western boundary at Fort Smith and flows in a southeasterly direction across the state to the Mississippi. The other more important streams include the White, Black, Ouachita, Saline, Little Red, and Bartholomew Bayou.

As stated above, Arkansas is famous for its mineral springs, and Hot Springs, a city in Garland County, is one of the greatest health resorts in the world. Over 1,000 acres in the vicinity have been set aside as Hot Springs National Park.

Rainfall and Temperatures. Rainfall averaging some 48 inches, with a fairly even distribution throughout the year, has favored the agricultural prosperity of the state. There is a growing season of 193 days from frost to frost in the extreme northwest, and an average of 240 days in the southeast. The south has long, warm

summers, and in some sections of the lowlands the heat becomes oppressive because of the high humidity. The winters here are rather mild, and spring and autumn are delightful. The highest temperature of the state occurs in the southwest at Texarkana, where the average for the year is 64.4°F .

In the north and northwest the climate is generally pleasant, without severe winds or protracted drought. The summers in the highland regions are notably cool, and



ARKANSAS, THE WONDER STATE

the winters there are much colder than in the lowlands.

Resources of Farm and Forest. About half of the entire land area of Arkansas is in farms, and agriculture is the principal source of the wealth of the state. Cotton is the leading crop. The rich alluvial soils along the Mississippi, Arkansas, and White rivers, and a section of black soil in the southwest, produce long-staple cotton, while short-staple varieties are grown in lighter soil and on the hill lands. In some years Arkansas ranks next to Texas in cotton production.



A RELIC OF THE OLD SOUTHWEST

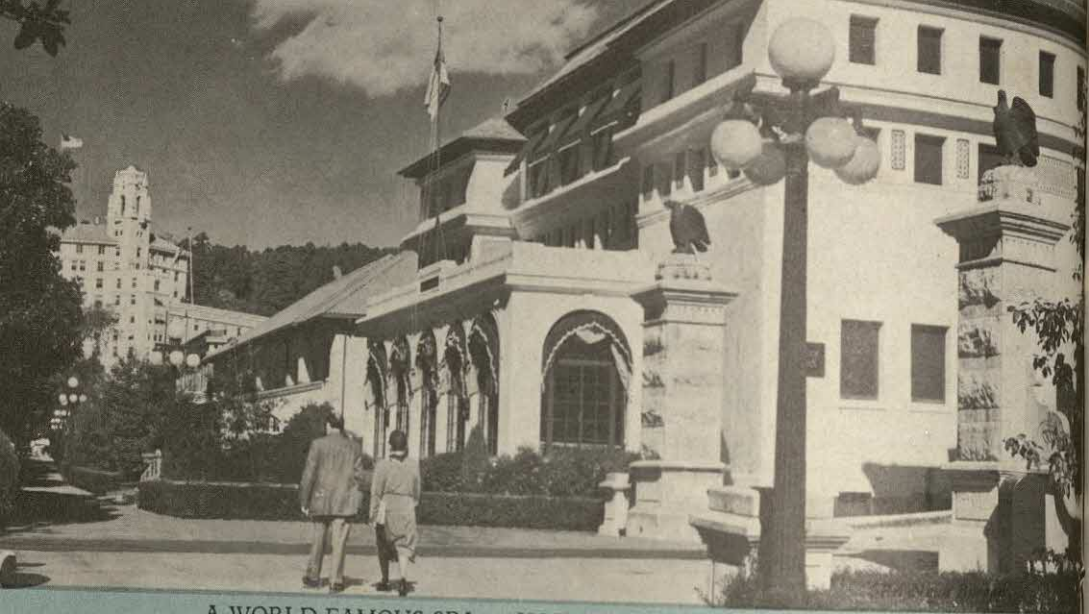
The old capitol building in Little Rock, built in 1834, is now the War Memorial.

Corn is produced in each of the seventy-five counties, growing on the tablelands of the Ozark region, on the black land, in sandy soil, and in the river-bottom areas. Second to corn among cereals is rice, grown chiefly in the eastern prairie section, on silt and sandy loam soils. Arkansas ranks high among the states in this crop. Tobacco and soybeans and rye, wheat, oats, and barley are also widely raised, as well as several grain sorghums and a variety of forage and hay grasses.

In vegetable and fruit production, Arkansas is one of the leading states. Cantaloupes, watermelons, strawberries, and other small fruits flourish, but the state is especially noted for its apples. The Ozark region is often referred to as "the Land of the Big Red Apple." Peaches, grapes, pears, plums, prunes, and cherries also add to the income of the fruit growers. Pecans are the most important nut crop.

The Ozark region is the chief dairy section. Here, also, are found beef cattle, hogs, sheep, and goats, while this section leads the rest of the state in poultry. Arkansas is one of the leading hog-producing states of the South. Large numbers of horses and mules are raised. Beekeeping is widespread, and much honey is produced and marketed.

The forests of the state constitute one of its greatest resources. Pine, cypress, and sweet gum grow in the southern and



A WORLD FAMOUS SPA — HOT SPRINGS NATIONAL PARK

Bath House Row is the showplace of this popular resort, which is located at the town of Hot Springs. The springs are grouped around the base of Hot Springs Mountain.

eastern parts, and many kinds of oak, hickory, ash, locust, cedar, maple, elm, and other trees in the northern and western sections. So great are the timber resources of Arkansas that the Federal government has established national forests in the state, the largest being Ouachita and Ozark, both in the western part of the state.

One of the great lines of business is the production of lumber and other forest and wood products. The state has about 129 varieties of native trees, sixty of which produce commercial products. The state leads in the production of red-gum (sweet-gum) lumber used in the manufacture of pianos and furniture. Arkansas furnishes an abundance of cedar for pencils and cedar chests and for other purposes. Spokes, ax handles, and other tool handles are made from hickory. Staves, wheels, wagon material, and flooring come from the oak forests. Material for veneering and for making crates and baskets and railroad ties is produced in great quantities.

Minerals. The leading mine industry is that of bituminous coal, which is of excellent quality and smokeless. Arkansas "semi-anthracite," as it is called, is supplied

in large quantities to the United States Navy. In the production of bauxite, from which aluminum is made, Arkansas is the first state in the Union, producing over ninety per cent of the entire output of the country and a large percentage of the world's supply. Natural-gas and oil fields add greatly to the mineral wealth of the state. Petroleum was not discovered here until 1921, but the industry developed so rapidly that oil now ranks first among mineral resources in value of annual production.

The only diamonds mined in the United States come from a mine in Pike County and are used for industrial purposes. Other products of this mineral-rich state include manganese, barite, novaculite for whetstones, antimony, cinnabar, rutile, marl, phosphate rock, chalk, zinc, lead, iron ore, building stones, pottery and fire-brick clay, and sand.

The People and Their Organization. In 1960 Arkansas had a population of 1,790,000, a decrease of 6 per cent from that of 1950. About three fourths of the people are whites, mostly native-born. Little Rock is the capital and the largest city of the state.

The University of Arkansas, at Fayetteville, heads the state's educational system. School attendance is compulsory between the ages of seven and sixteen.

The governor and other state officials are elected for two years. There is a two-house legislature.

History. The name *Arkansas* comes from the early French explorers' mispronunciation of *Quapaw*, the name of one of the Indian tribes, meaning *Downstream People*. The first permanent white settlement was made by the Frenchman, Henri de Tonti, in 1686 — over a century after De Soto had seen the hot springs that give the state's chief health resort its nickname, the "Baden-Baden of America." Arkansas became the property of the United States through the Louisiana Purchase of 1803. The Territory of Arkansas was organized in 1819.

Arkansas was admitted to the Union in 1836. It belonged to the Confederacy during the War between the States and adopted its present constitution in 1874. Examples of its industrial progress are its many mines, sawmills, wood-products factories, cotton gins, cottonseed, petroleum, and mercury refineries, and food-processing plants. The construction of huge, new bauxite refineries in Arkansas in the 1950's added to the state's industrial importance. See LITTLE ROCK; OZARK MOUNTAINS.

ARKWRIGHT, *ark'rite*, RICHARD (1732-1792). From the first hand-sewn skins to the finished cloth of our modern factories is a long story. Richard Arkwright, an Englishman who started life as a barber's apprentice, has an important place in that story. He was born in Preston, a town in Lancashire. Richard received very little schooling, and his father, struggling to provide for a family of thirteen children, had him learn the barber's trade. Later Arkwright set up a shop in Bolton, in a cellar.

He had grown up in a district where cotton spinning was carried on, and became interested in improving the crude machines then in use. In 1767 James Har-

greaves had invented a spinning machine which he called a "jenny," probably for his little girl. This device enabled the cotton worker to spin a number of threads at a time. However the threads were not strong enough to be used for the warp, or lengthwise threads, and for this purpose linen was employed.

After much study and experiment, Arkwright brought out his spinning frame, which was such an improvement that it caused a great expansion in the textile industry. Today, Arkwright is called "the father of the modern factory." He took out his first patent in 1769.

Arkwright feared that the cotton workers of Preston would destroy his machines, for these poor workmen believed that machinery would throw them out of work. Accordingly he set up a cotton mill at Nottingham, which was run by horse power. He later became a prosperous owner of cotton-spinning and weaving mills, and in 1786 he was knighted by King George III. See SPINNING.

ARMA'DA. The scarlet and yellow flag of Spain blazed aloft. Guns gleamed in the early sun, and rows of oars flashed on the water. All hands were on deck, and, at a brisk command, the Invincible Spanish Armada, 130 ships strong, took to the salty brine.

The year was 1588, and Spain was mistress of the seas. Queen Elizabeth of England had beheaded Mary, Queen of Scots, who was a Catholic, and churchmen throughout Europe urged that England be punished. English sea captains had destroyed Spanish shipping, captured great booty, and attacked Spanish settlements. King Philip II of Spain, proud and confident, announced that he would conquer the arrogant nation.

Gold poured in from the Church, and with this and every dollar that he could wring from the people, Philip costumed his men in sparkling coats of mail, and decorated his many-decked galleons. These were castles of the sea, heavy at stem and stern, manned at the oars by slaves, and



A CONQUERED FOE SURRENDERS TO DRAKE

England became queen of the seas when Sir Francis Drake and his captains defeated the immense but unwieldy Spanish Armada. This is a scene on Drake's flagship, the *Revenge*, showing the surrender of Pedro de Valdez, a commander of one of the squadrons.

on the decks by thousands of soldiers, sailors, and priests.

The fleet was called an armada. The bungling Duke of Medina led his ships, like a winding serpent, through the English Channel toward Calais, where he was to meet the Duke of Parma, with his army, so that together they might rout the English. But long before Calais, the billowing sails of Philip's galleons were flying shreds, and the blood of his men darkened the channel.

England, cleverly in wait for the lumbering armada, bided her time. With almost an equal number of smaller, swifter ships, her brilliant commanders, Howard, Drake, Hawkins, and Frobisher, forced the Spaniards toward France. Here, hoping for the arrival of Parma, the already battered Spaniards lay low. At midnight, with favorable winds, England attacked

again, this time letting loose a fleet of fire-ships, showering flame and smoke among the panic-stricken enemy. Sails reddened, and the cliffs of Dover glowed with a rosy light, as the confused Spaniards battled, man to man, for their lives. Their shots missed fire, and their top-heavy, overmanned ships only served as targets.

Desperately they headed for open sea. At dawn, the blood-soaked ships of the armada were again lashed by a ferocious storm, and again by the indomitable British. Crippled and discouraged, they sought to get back to Spain by rounding Britain on the north. Storms whipped them all the way up the rocky coast, sending galleon after galleon to the bottom. Less than fifty survived the sad voyage back to Spain. The war and the pride and the glory of Spain were lost, and England became queen of the seas.

ARMADILLO, *ahr ma dil' o*. Many of us have read about armadillos in Kipling's *Just So Stories* or have seen baskets made of their horny body coverings, but few North Americans have seen them alive. They are found for the most part in South America, though the nine-banded armadillo is found as far north as Texas.

These animals are called armadillos (Spanish for *small and armed*) because of the bony armor which covers their bodies and makes it possible for them to protect themselves from any of their enemies by simply curling up. This armor is in sections. There is a firm section over the forward part of the body and a section over the rear. Narrow bands protect the region between. There are plates of armor on the animals' heads and armor on their legs and tails.

Armadillos have small teeth, and most of them take for food, insects, soft plant parts, fruits, and decaying flesh. Fitted for digging, the feet are provided with large, strong claws. These animals are placed by zoölogists in a low order of mammals.

Among the better-known armadillos are the *nine-banded*, which reach a length of thirty inches. The *giant* armadillos are the largest, reaching a length of four feet. They are rare animals of the forests of Brazil. The *hairy* armadillos are found in the Argentine Republic, where they are hunted for their flesh. They are about a foot and a half long.

AR'MATURE. If we place a piece of soft iron across the poles of an ordinary magnet, it becomes a part of the magnet, by concentrating the lines of force (see **MAGNETISM**). In a dynamo or electric motor the armature is theoretically the same, but is very different in appearance. It consists of a core about which wires are wound. It is either rotated past the magnetic poles or remains still while the poles are led past it. See **DYNAMO**.

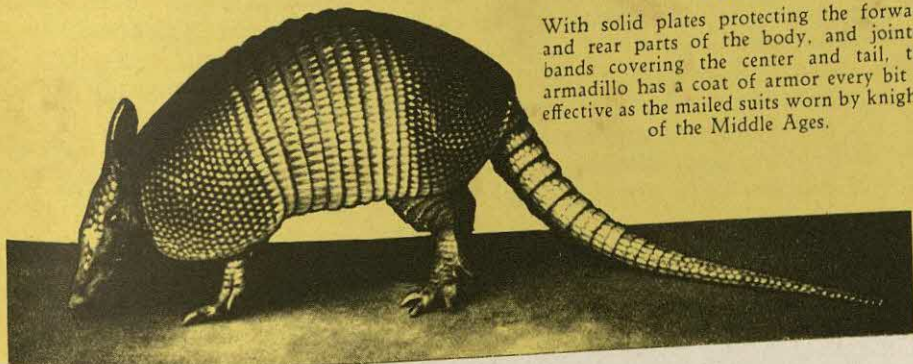
ARME'NIA. In Western Asia, halfway between the Black Sea and the Caspian Sea, lies the territory which we know as Armenia. It is the land referred to in the Bible as Ararat. At the time of the first World War, Armenia was really partly in Turkey, partly in Russia, and partly in Persia. At various times it has been invaded by Turks, Persians, and Arabs. Even in ancient days it was overrun by Byzantines and Mongols.

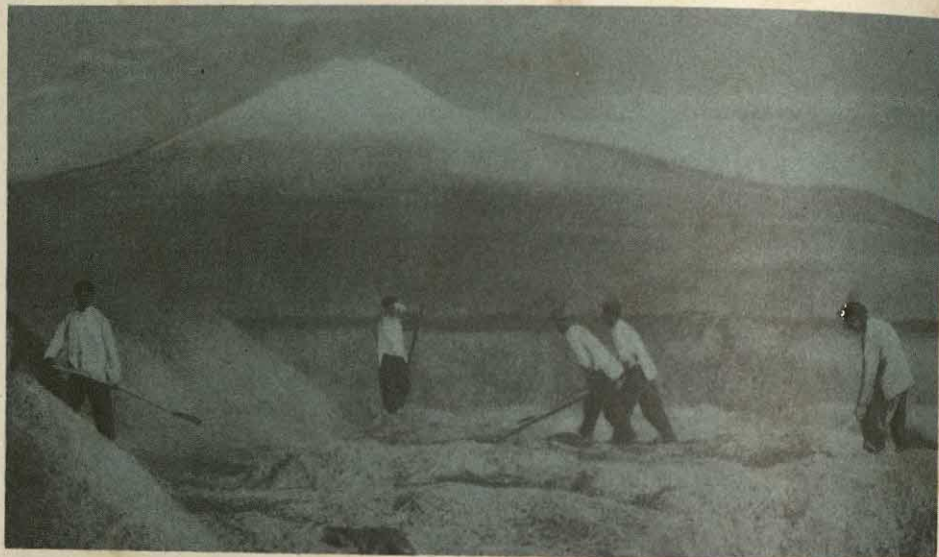
Armenia is a fertile country, the principal crops being cotton, corn, rice, tobacco, grapes, and dates. There are fine pasture lands, too, and forests abounding in ash, maple, oak, walnut, pine, and chestnut. In the mountainous regions there are also many minerals, such as silver, lead, iron, and copper.

The Armenians are usually a very intelligent people. With opportunity, they become successful merchants, doctors, lawyers, and teachers. But they have hardly had the chance to pursue any occupation except that of simple farming. In Turkish

AN ARMORED "KNIGHT" OF TODAY

With solid plates protecting the forward and rear parts of the body, and jointed bands covering the center and tail, the armadillo has a coat of armor every bit as effective as the mailed suits worn by knights of the Middle Ages.





WHERE NOAH'S ARK FINALLY CAME TO REST

After the Deluge, or great flood, described in the Bible, Noah's Ark came to rest on Mount Ararat, the highest point in ancient Armenia.

Armenia, especially, the people were kept in ignorance. Frequent massacres and persecutions also prevented progress. In Russian Armenia, however, the people fared better and were allowed some education and an opportunity to develop.

Armenia has had a disturbing history. The country was conquered by Alexander the Great in 325 B. C. About 150 years later the Armenians regained their independence. Then, in 69 B. C., the Romans came and made the land a Roman province. Persia and the Byzantines later divided the land between them. Christianity was introduced by Gregory the Illuminator in the year 285. Shortly afterward, the Armenians founded the first Christian church in the world.

The Persians plunged the country into chaos in their attempt to drive out the new religion. But the Armenians held to their faith. They again suffered because of their religion when the Arabs conquered the country in the eighth century. Quarrels between Christians and Mohammedans were common, but during the ninth century, there was an interlude of peace.

However, peace did not last. Armenia was invaded by the Byzantines, Mongols, and Seljuk Turks, and was finally divided between the Byzantines and Timur. The Persians conquered the country again in 1472, and in 1828 Russia seized part of it. Finally the land was divided among Turkey, Russia, and Persia. In 1885 the Turkish Armenians attempted a revolution, but they were defeated and were afterwards persecuted mercilessly. Christian nations throughout the world protested to the Turkish government.

After World War I, conditions in Armenia were again chaotic. In 1921 the country organized itself into a Soviet republic and later joined the Transcaucasian Soviet Federated Socialist Republic. In 1936, however, Armenia became an independent Soviet, one of the family of republics which compose the Union of Soviet Socialist Republics. Now, better schools, irrigation systems, and hydroelectric stations are helping to improve conditions among the Armenians. Present-day Armenia covers about 12,000 square miles and has a population of about 1,770,000 people.

ARMIES MARCH IRONCLAD THROUGH THE BATTLES OF HISTORY . . .

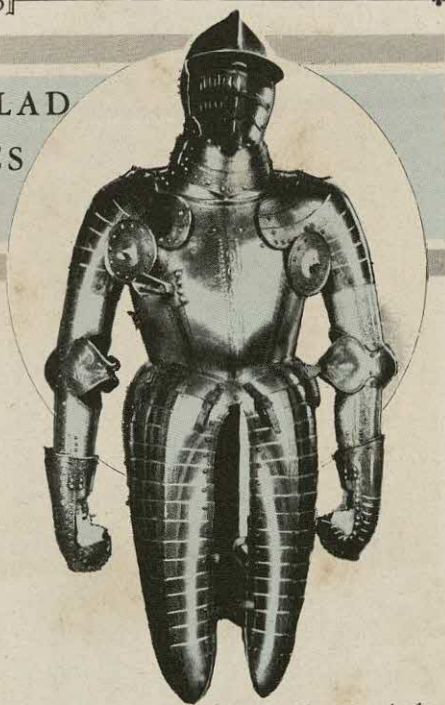
AR'MOR. In the Middle Ages, when war was waged on open fields, warriors rode to battle in suits of metal weighing seventy pounds or more. This was the era of armor, and hardly a nobleman of the time would think of taking the field without being encased from head to foot in this costly but necessary protective covering.

When a knight of the fifteenth century prepared for battle, he took a long time in dressing. First he put on his cloth underclothing. Then, assisted by his squire, he donned a heavy breastplate that would withstand the thrust of a lance or spear. Next, a backplate was attached to protect him from an attack from the rear. Shoulder and arm guards, a waist piece, loin guards, thigh protectors, knee guards, and greaves, which covered the lower part of his legs, all were fastened on with buckles, locks, and rivets.

Finally, metal shoes, iron gauntlets, and a helmet which not only protected the top and side of the head but the neck and face as well, were put on. He was now fully dressed. Outside, he was lifted on his sturdy horse, which also had been covered with plate armor, and off he rode to join his comrades on the field of battle.

This type of armor was the pride of the armorer, one of the most skilled craftsmen of the day. It was the most advanced type of armor yet devised, the result of hundreds of years of experience in protecting men in warfare.

Armor had its beginnings before the time of written history. An early form of protection was the shield which was used by the first Greek armies. The shield then was of immense size, but by the time of



the Peloponnesian War, 400 years before Christ, it was much smaller.

Helmets have been worn in warfare from the time of the Assyrians to the present. The earliest types were made of bronze and were decorated by the Greeks with lofty crests. The Roman helmet fitted close to the head and had a neck guard, cheek pieces, and a bar across the face. Both Greeks and Romans wore short skirts of metal material for protection. The Greeks protected both legs, while the Romans covered only the right leg, since the shield was worn on the left side.

During the Middle Ages, the short metal skirts of the Greeks and Romans became longer. Men who fought found that they needed more protection. Their armorers sewed small metal rings to a tunic which later developed into a mesh of interlocked rings known as chain mail.

The Normans wore chain-mail armor which reached from the neck to the knee when they conquered England. They also wore a pointed iron helmet with a nose guard. Heavy plate armor came later, and with it the best armorers of Europe



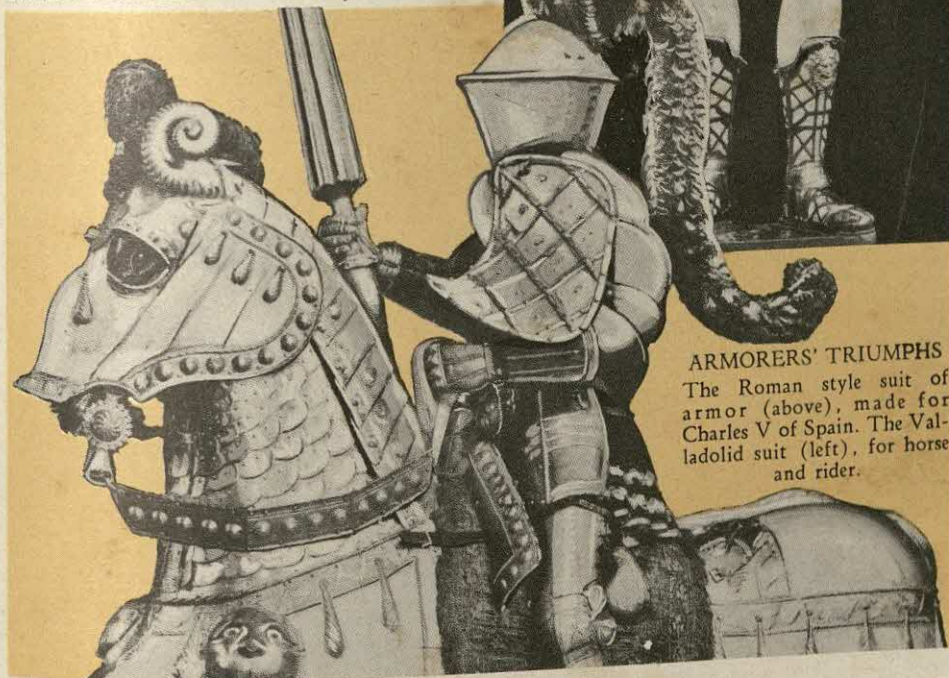
WHEN THE BLACKSMITH WAS THE TAILOR

These sketches show the development of armor through many centuries—from the early Assyrian armored soldier to the invention of gunpowder, which meant the end of the ironclad warriors. At first, armor protected only the most vital parts of the body, but, as weapons became more vicious, armor became more complicated, until, toward the end of the Middle Ages, it clothed the fighter's body from head to foot in shining steel. The figure in the center indicates the various parts of a complete suit of armor. This sort of battle array was not limited to the soldier himself. His horse, too, was often entirely encased in a similar layer of sheet metal, so that the enemy could harm neither rider nor steed. But after the crossbow, gunpowder, and rapid maneuvers came into use, all such armor except the helmet was gradually discarded.

developed their art to its summit. Their suits permitted the wearer to move freely despite the heavy weight, and they were so made that most blows glanced off the metal.

Perfect as armor was as a protection against lances, swords, and spears, doom was written for it in the Battle of Crécy between the English and French, in 1346. There, the English yeomen, using the six-foot longbow for the first time, defeated the heavily armored French horsemen. The three-foot arrows pierced the armor plate, proving that metal no longer was a perfect protection. Armor was worn for many years afterward, however, and it was not until gunpowder and fast maneuvers came into use that it disappeared.

The metal helmet worn by troops in World Wars I and II, however, has been retained; some of these modern helmets are equipped with visors. In World Wars I and II, body armor was developed. Armor plate also is used to protect battle-ships and army motor vehicles. The covering of football players is a form of armor handed down from the old days.



ARMORERS' TRIUMPHS
The Roman style suit of armor (above), made for Charles V of Spain. The Valadolid suit (left), for horse and rider.



U.S. Army Photograph

MIGHTY WAR MACHINE
An American tank moves into action.

ARMY. After a light fall of snow, boys at play choose sides, pick leaders, and set to building opposing forts. In organizing for a snow fight, they form two armies: one boy will sneak around to attack the enemy at the rear; another will make snowballs for a third who throws well. Likewise, an army is a body of men in the service of a country or a leader, armed and organized for warfare on land.

Armies of the Past. In the beginning,

armies were probably formed as simply as boys gather for a snow fight. Ancient records of an organized army tell of the Egyptians, who had archers, charioteers, and infantry. Later on, when the Persians came out of the East to invade Greece, they had foot soldiers, or infantry; horsemen, or cavalry; and a section for siege weapons — battering rams and stone throwers or artillery, much as in a modern army.

The Persians used cavalry for many a victory, riding down enemy foot soldiers and scattering them. In the skillful use of army units, however, there has probably never been one more expert than Alexander the Great, the Macedonian conqueror of Persia. Using as a fort the Greek phalanx, a solid block of men confronting the enemy with leveled spear points, Alexander moved his cavalry around one side of the enemy, and struck from the rear.

In Persia, he added to his then hired soldiers many units of artillery or stone-throwing catapults, siege engines, and elephants. The formal organization he perfected—the co-ordination of infantry,

ARTILLERY AND INFANTRY FORM A FIGHTING TEAM

Gun crews prepare the way for the advance of the infantry. Riflemen like the one at left, below, carry grenades along with their other field equipment.



cavalry, and the artillery — was used a century later by Hannibal of Carthage, when he challenged the rising citizen army of Rome with his mercenaries.

The Romans knew army organization. Like the Spartan Greeks, they were a nation in arms, but, being independent of spirit, they could never fight for long as a unified body. They conquered their world, but they lost it; they hired soldiers who had not their spirit; they came to use cavalry for policing the empire; too heavily armed, the horsemen were no match for the fierce barbarians.

In the Middle Ages, cavalry continued to be the main offensive unit of the army. Even the best of infantry, armed with pike and halberd, were no match for armored knights and armored horse. There began in the fourteenth century, however, a new organization of army units, with the cavalry and light infantry still on the flanks of the heavily armed men in phalanx, but with the phalanx shooting accurately with arrows.

This tendency continued after the introduction of guns, until cavalry could no

longer penetrate infantry ranks. Lightly armed men, such as modern infantry, can spread out, offer little target, and still ward off the enemy. With the growth of cities, it was natural that they send out their armies as infantry.

Gustavus Adolphus of Sweden first organized his army according to the modern scheme. He formed his troops in a line, with the infantry flanked by cavalry as before, but he smashed the phalanx of the enemy with heavy gunfire before he charged them and closed in hand-to-hand combat. Frederick the Great of Prussia began the system of ordered drill which came down to the present day through the rise of the Prussian state. When Napoleon conquered Europe, he used the same strategy, more or less, as had all the distinguished generals who preceded him.

With the improvement of rifles and big guns, armies have had to move back from one another and fight at a distance. In anything but settled trench warfare, cavalry still has its use for scouting and land survey; horses are still used by armies to take them where machines cannot go. The



MODERN WARFARE CALLS FOR FAST MECHANIZED EQUIPMENT

Left, British forces crossing the Volturno River in Italy; using prefabricated metal treads, army engineers can rapidly construct pontoon bridges that will hold the heaviest tanks or guns. Right, long lines of U. S. Army mechanized units advancing in North Africa; with caterpillar treads to provide traction, huge machines of war can move swiftly over difficult terrain.



THE UNITED STATES ARMY OFFICERS' INSIGNIA

By these uniform badges, officers and men of different commands recognize rank and authority in the Army. Left to right: Captain; Major (gold); Lieutenant-Colonel (silver); Colonel; Brigadier-General. A full General of the Army wears five stars.

infantry has to dig into trenches to escape deadly rifle fire. The real offensive weapon, artillery, has at last had to move to the rear of its army and fire at the enemy over the heads of the infantry.

In addition, the modern army has units to attack with burning chemicals, and air arms to attack and observe from the air as well as services of supply and transportation, intelligence to gain enemy secrets, medical corps, and so on. Armies have come to be complex and highly specialized in their several branches.

The United States Army. So the modern army is far different from boys in a snow fight. The United States Army, while it may not be typical of all armies, will give in its make-up some idea of a complex military organization. It is commanded by the President, and is administered as one of the three units making up the Department of Defense; the others are the Navy and the Air Forces. A Secretary of the Army is responsible for Army affairs, and is answerable to the Secretary of Defense, who, as head of the Department of Defense, is a member of the President's Cabinet. The Army of the United States consists of the Regular Army, the National Guard, the Officers' Reserve Corps, the Organized Reserves, and the Enlisted Reserve Corps. These units form a peacetime framework on which a large force of trained men can be organized in time of national emergency.

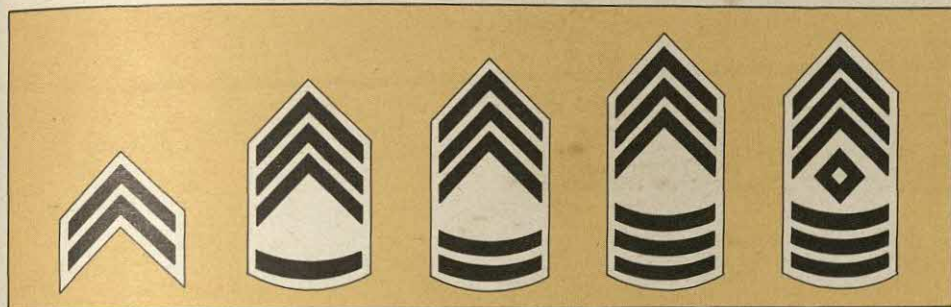
The Regular Army includes these units: The General Staff, the Adjutant General's Department, the Inspector General's Department, the Judge Advocate General's Department, the Quartermaster Corps, the

Finance Department, the Medical Department, the Ordnance Department, the Chemical Corps, the Transportation Corps, the Corps of Chaplains, the staff and cadets of the United States Military Academy, and officers and men on detached service or retired list.

The combatant arms include the Infantry, Cavalry, Field Artillery, Coast Artillery, Armored Division, the Corps of Engineers, and Signal Corps.

The basic infantry units of the army are the squad, platoon, company, battalion, regiment, division, and corps. The squad is the largest unit that can be commanded personally by one leader. It is headed by a sergeant, with a corporal second in command, and consists of twelve riflemen. Three platoons of riflemen and a headquarters platoon with heavier arms make up the company, commanded by a captain. Three rifle companies and a company armed with machine guns and mortars compose the battalion, under a lieutenant colonel, with a major as executive. A regiment, in command of a colonel, consists of three battalions, besides headquarters and service companies. Three regiments are combined to form the division, under a major general. Divisions, in turn, are combined to form a corps, in charge of a lieutenant general. All the corps together make up the field army.

History of the United States Army. When the colonies declared themselves in revolt from England, there began the enrolling of volunteers under colonial officers led by George Washington. After the victory of Washington's forces, which had numbered 22,000 men, the Congress of the



Corporal

Sergeant

Sergeant 1st Class

Master Sergeant

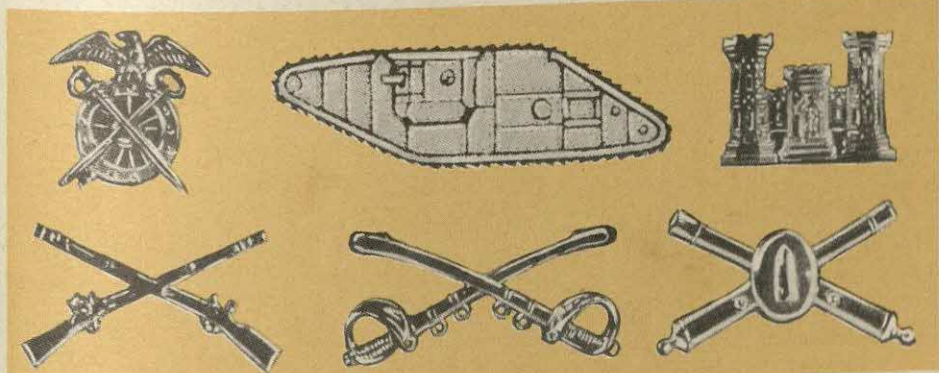
First Sergeant

growing United States, in 1789, fixed the organization of the army at 1,216 men. Through the Indian wars and the War of 1812, and finally the War with Mexico, in 1848, the number of men was gradually increased until at the beginning of the Civil War in 1861 the regular force of men amounted to 14,000. After the enrollment of the Civil War, which brought nearly 4,000,000 men, of both North and South, under arms, the army continued to grow; in 1901, 58,000 men was the minimum enrollment; in 1916, when there was trouble along the Mexican border, the army was enlarged again to an authorized number of 175,000 men.

World War I made the need for a greater army apparent. By the passage of the Selective Service or Draft Acts in 1917 and in 1918, and by making the National Guard a Federal organization, the men

under arms at the close of the first World War numbered 3,665,000.

There followed a gradual reduction in the armed forces, but the outbreak of hostilities in Europe in 1939 and the subsequent involvement of the United States in World War II brought about revolutionary changes in the military policy of the country. In 1940 a Selective Service Act was passed which ordered the registration of men between 21 and 35 years of age (inclusive) and fixed the period of training at 12 months. As amended, the act extended the period of service and changed the age limits. Selective Service continued throughout World War II, and in 1948 a new program of registration and induction was begun to build up the armed forces. In a thorough reorganization of the armed services in 1947, the Air Force was made a separate branch.



UNITED STATES ARMY CORPS INSIGNIA

American officers are proud to wear the symbols of their branch of the service. Left to right, above: Quartermaster; Armored Force; Engineer Corps. Below: Infantry; Cavalry; Coast Artillery.



By telephone, teletypewriter, and radio, Field Headquarters (left) guides the action of the far-flung fighting units on land, at sea, and in the air. Courtesy Western Electric

The casualties of World War I caused a deep reaction against war in many countries, and a movement to reduce armies and navies gained great strength. Germany, however, refused to abide by the provisions of the Versailles Treaty limiting the size of its army and, after the rise of Adolf Hitler, developed one of the mightiest armies the world has ever seen. A general mobilization of the armies of Europe followed.

To protect the country from another German invasion, France constructed the powerful Maginot Line; Germany constructed a similar line—the Siegfried Line, or West Wall—facing it across the Rhine. The strength of these fortifications caused a stalemate for several months on the Western Front in World War II. In its invasion of Poland, Germany showed the power of attack by a mechanized army supported by airplanes and artillery. This system was rapidly adopted by other armies. See ARTILLERY; CONSCRIPTION; INFANTRY; WORLD WAR I; WORLD WAR II.

ARNOLD, BENEDICT (1741-1801). America remembers Benedict Arnold chiefly as a traitor who betrayed his country during the Revolutionary War. Yet, despite his disgraceful conduct, history cannot obscure Arnold's brilliant leadership as a soldier.

He was born in Norwich, Conn., where he received a common-school education. When the Revolutionary War broke out, Arnold entered the army and led an expedition to capture Crown Point and Ticonderoga. Ethan Allen's Green Mountain Boys seized Ticonderoga before Arnold arrived, but four days later he took Saint John's.

In the fall of 1775, Arnold joined General Montgomery in an attack on Quebec and suffered a leg injury. Although defeated, he was promoted to the rank of brigadier general. The following year he commanded a fleet on Lake Champlain and prevented the British from capturing his vessel by running it ashore and burning it.



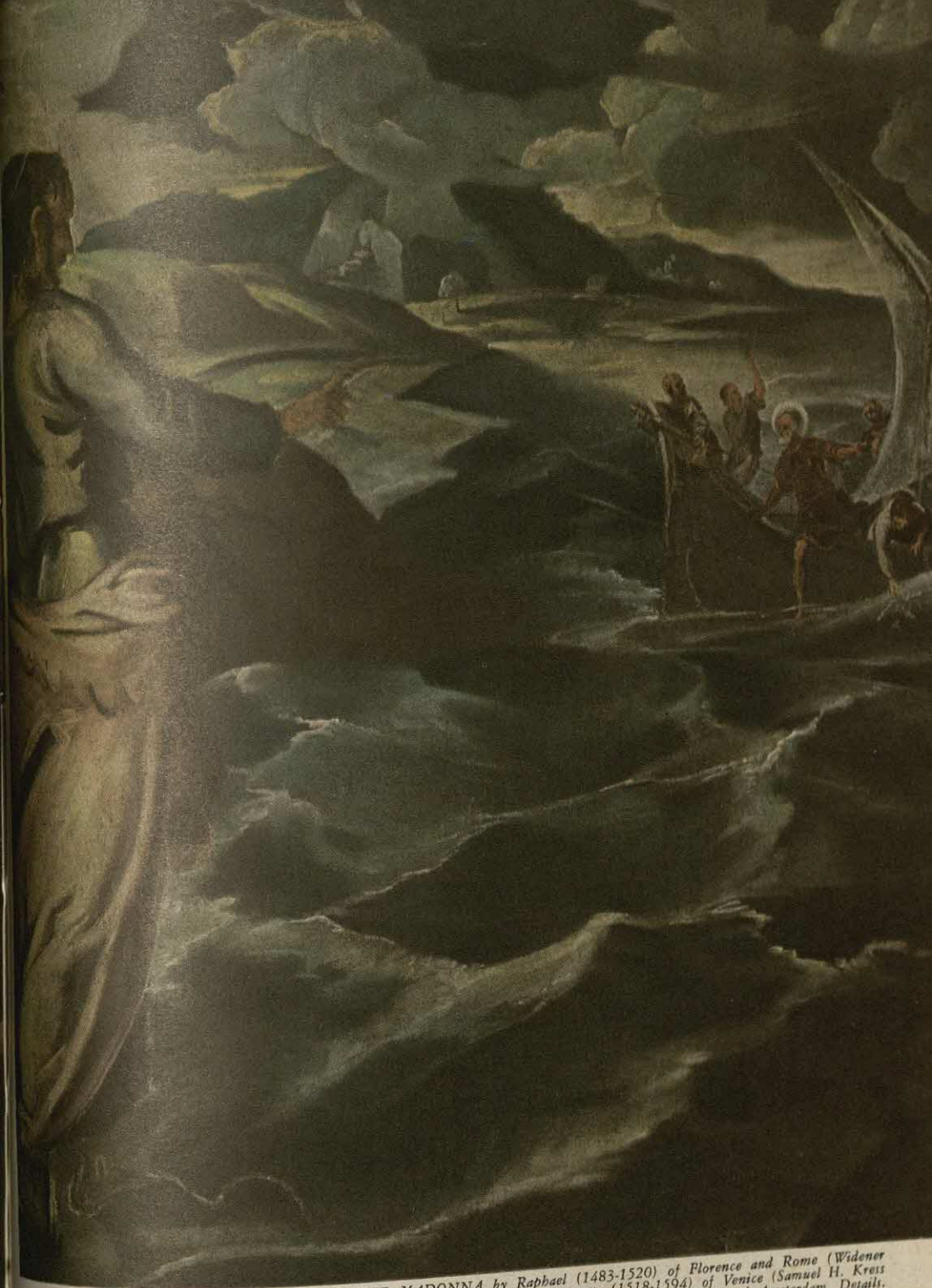
THE ADORATION OF THE SHEPHERDS by Giorgione (1478-1510) of Venice; detail (Samuel H. Kress Collection).
All four paintings courtesy of National Gallery of Art, Washington, D.C.

The Life of Christ in Paintings

ART, RELIGIOUS. Love for God has inspired most truly great art. God so loved men that He gave His only begotten Son

Son Jesus Christ began in a humble manger in Bethlehem. Shepherds heard the angels herald Jesus' birth, and came to adore Him.





Opposite page **THE SMALL COWPER MADONNA** by Raphael (1483-1520) of Florence and Rome (Widener Collection); above: **CHRIST AT THE SEA OF GALILEE** by Tintoretto (1518-1594) of Venice (Samuel H. Kreis Collection); next page: **THE DESCENT FROM THE CROSS** by Rembrandt (1606-1669) of Amsterdam, Details.

▶ **RAPHAEL'S MADONNA** expresses the purity and power of the Virgin Mary and her Divine Son. The Holy family fled to Egypt to escape Herod. When Jesus was twelve, he debated with the priests.

▶ **"COME, FOLLOW ME,"** said Jesus to His first disciples, "and I will make you fishers of men."

▶ **CHRIST DIED ON THE CROSS** to redeem mankind. Joseph of Arimathea claimed Christ's body and took it to a tomb. But Christ arose, and on the fortieth day was taken up into Heaven.



Arnold was greatly disappointed in 1777, when the Continental Congress appointed five officers, all of them his juniors, to the rank of major general, overlooking him. Although General Washington promised that he would try to remedy the "error," Congress merely gave a vote of thanks to the brilliant commander.

Following distinguished service in the campaign against Burgoyne, who was forced to surrender, Arnold was given his commission as a major general. He was placed in command of Philadelphia, but was court-martialed after quarreling with local authorities. Even though he was found innocent of any deliberate wrongdoing, his conduct was declared improper.

Through several Tory families, connections of his second wife, Margaret Shippen, he corresponded with the British general, Sir Henry Clinton. When appointed commander of West Point in 1780, Arnold at once made plans to surrender the fort to the British. The plans did not succeed, for Major André, the British agent sent to negotiate with him, was captured by Americans. Following this exposé, Arnold fled to New York City, where he was made a British brigadier general and paid a sum of money. Despised and shunned by British and American alike, Arnold died in obscurity in 1801.

AR'SENAL. During times of war, probably the most heavily guarded buildings are the storehouses in which guns, arms, and other munitions are kept. These buildings are called arsenals. The first in the United States was built at Springfield, Mass., in 1777. Arsenals are now maintained also at Pittsburgh; Augusta, Ga.; Benicia, Calif.; Columbia, Tenn.; Fortress Monroe, Va.; Philadelphia; Indianapolis; Augusta, Me.; Governors Island, N. Y.; Rock Island, Ill.; Jefferson Barracks, Mo.; Sandy Hook, N. J.; San Antonio, Tex.; Dover, N. J.; Watertown, Mass.; Watervliet, N. Y. The arsenals at Watertown, Dover, Watervliet, Philadelphia, Rock Island, and Springfield manufacture ordnance materials for the army.

An artillery proving ground is located at Aberdeen, Md., and other artillery depots are situated at various points throughout the country.

An arsenal, abandoned many years ago, was built at Harper's Ferry, W. Va., in 1795. It is famous in history, having been captured by John Brown, an ardent abolitionist, and a group of friends, in 1859. Brown's intention was to supply slaves with weapons in a general uprising. The move was a failure and Brown was captured and hanged.

AR'SENIC. Like many other common substances, arsenic can be very useful, but it is also extremely dangerous if used improperly. It is a metallic element that is nearly always found in nature combined with other substances. It is employed in the formation of pigments, as a flux for glass, and as a medicine, especially in skin diseases. When combined with oxygen, it forms two compounds, white arsenic and the arsenic of the shops. Other compounds, arsenite of copper and double arsenite and acetate of copper (emerald green), are used by painters and sometimes in the coloring of paper hangings for rooms. The latter is a dangerous procedure, especially if the room is not well ventilated.

Arsenic has been employed in the manufacture of cheap confectionery in order to obtain a bright green color, but this practice is now illegal. It is sometimes used as a dye for clothing. In its various forms it has been known to have caused many deaths, being a virulent poison.

In its native state, arsenic is dark gray in color, turning yellow and then black on exposure to air. The commercial product is a white powder. Arsenic equals copper in hardness and is extremely brittle. A smell of garlic is emitted when it is burned, a blue flame forming. Arsenic will form alloys with most metals, and is usually obtained from the earth in combination with other metals in ore.

AR'TERIES. Blood circulates in the body through two sets of blood vessels,

the arteries and veins. The arteries convey the blood away from the heart, while the veins carry it to that organ.

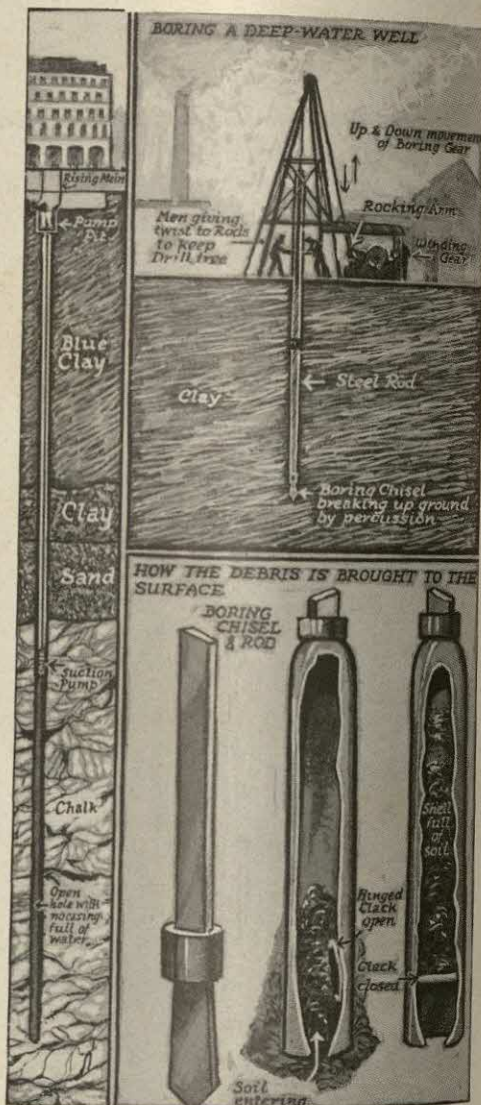
Two large arteries rise from the heart. One of these, the pulmonary, leading from the right ventricle, carries impure blood to the lungs. The other is the aorta. Rising from the left ventricle, it carries the pure, bright red blood to all parts of the body. As the aorta proceeds from the heart it divides and subdivides into numerous smaller arteries. Finally, these smaller arteries end in very minute capillaries. The capillaries unite the ends of the arteries with the veins and the impure blood is returned to the heart through them.

The arteries are made up of three coats. The outer coat is elastic. When the heart-beat forces blood into the arteries, the coat expands to take care of the increased flow of blood. The middle coat is made up of muscular tissue, which regulates the size of the blood vessels. The inner coat is smooth, so that the blood will flow along easily. As the arteries get smaller, the elastic tissue decreases. The tiny capillaries are composed almost entirely of the smooth, inner-lining cells.

The life of every part of the body depends upon its supply of arterial blood. The tiny arteries are joined with one another in a network. If the blood supply is cut off from one of these small arteries, it may go through another.

The blood that flows from a wounded artery is bright red in color. It comes out in spurts or in an uneven stream. To check the flow of blood from an artery, press on the artery between the wound and the heart. See BLOOD; CIRCULATION; VEINS.

ARTESIAN, *ahr te' zhan*, **WELL**. It is often necessary to dig very deep into the earth for water—so deep, in fact, that long, thin drills must be used instead of picks and shovels. A well drilled in this way is an artesian well, named after the French province of Artois, where such wells were first used.



WATER FROM THE DEPTHS

A cross section of an artesian well which sucks water from springs far below the surface of the earth, and the methods and tools used for drilling.

The water which comes out of artesian wells lies far below the surface, in a layer of porous rock or gravel. This layer is formed in waves, so that at some points it appears on the surface. In this way rain is absorbed by the porous substance, and carried down along the layer. Wells may be drilled, then, through the clay and earth above the water-carrying layer. If the top of such a well is below the point

where the porous layer comes to the surface, the water will flow from the well. Otherwise it must be pumped out.

The water in most artesian wells is quite pure, and may be used in the home with safety. Artesian wells are very common where other water supplies are not available, and they often supply enormous quantities. They are even used for irrigation water in many dry regions.

ARTHUR, CHESTER ALAN (1830-1886). Very few people ever expected Chester Alan Arthur to become President of the United States, and almost nobody believed that he was fitted for the nation's highest office. But during his short term in the White House, as the twenty-first President, Arthur lived up to his opportunity and proved that he was indeed worthy of the office of Chief Executive.

Arthur became President by the route of the Vice-Presidency, automatically taking office when Garfield was assassinated. He had not been considered as "Presidential timber," and took the honorable but not very influential post of Vice-President in a political move. But when Fate handed him the leadership of his country, Arthur showed qualities of honesty and ability which brought him popular support.

His Rise in Politics. Chester Alan Arthur was born at Fairfield, Vt., on October 5, 1830. His father, an Irish immigrant, was a teacher and Baptist minister, and his mother an American woman of

Scottish descent. The young Arthur was graduated from Union College, Schenectady, N. Y., in 1848, and studied law. He practiced in New York with considerable success, during the period just before the

Civil War. It was not long before Arthur became one of the city's most distinguished lawyers. His best-known case was one involving the position of Negroes in the North, and it was through Arthur's successful work as counsel for the Negroes that they gained equal rights with whites on the New York street-railway system.

After the Civil War, Arthur entered state and city politics in earnest, joining the Republican party. In 1871 he was appointed collector of customs for the Port of New York by President Grant, and served for some years

in that capacity. Arthur filled the customs offices with political appointees, just as did other officials of the day. When this application of the spoils system came to the attention of President Rutherford B. Hayes, Arthur was removed from office under orders from the White House. At the time, Hayes was deeply interested in reforming the civil service, and Arthur unfortunately gained the reputation of opposing such reform.

He then joined the political organization of Roscoe Conkling, and thus entered the field of national politics. In the Presidential campaign of 1880, Arthur was active in the Grant-Conkling wing of the Republican party. During the national



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CHESTER A. ARTHUR

Twenty-first President of the United States
Administration, 1881-1885

He became president following the assassination of President James A. Garfield in 1881. Although his reputation was clouded by machine politics, Arthur proved to be an able, honest, and dignified chief executive.

convention of that year, the platform of this faction was defeated, but the delegates nominated Arthur Vice-President as a concession to his supporters.

Side-whiskered, affable "Chet" Arthur went to Washington, a relatively obscure political figure. It was only a few months later that President Garfield was shot fatally, and Arthur took the oath of the highest office in the land.

The Twenty-first President. The new President promptly quieted widespread fears that he was not equal to his responsibilities. In the first place, he made appointments which were above criticism. This was extremely important to his success, because newspapers had loudly expressed dismay at Arthur's record of political bargaining, and his resistance to civil-service reform. Instead of following the old partisan tactics, Arthur encouraged extension of the civil service, and one of the outstanding achievements of his administration was the passage of the Pendleton Civil Service Act, in 1883.

Other legislation included the organization of a territorial government for Alaska, a new tariff law, a Chinese exclusion act, and adoption of a two-cent postage rate.

Three transcontinental railroads were built during Arthur's term, and the same years saw the completion of the Brooklyn Bridge, the organization of the American Red Cross Society, and the staging of one of America's first great fairs—the Atlanta Cotton Exposition. Two of the nation's foremost writers died in 1882—Ralph Waldo Emerson and Henry Wadsworth Longfellow. At the close of the administration, the Washington Monument was dedicated.

President Arthur's political star waned toward the end of his term, and though his name was put up for a second four years, the 1884 Republican convention nominated James G. Blaine. Arthur lived only two years after that. He died in New York City on November 18, 1886, and was buried at the state capital, Albany.



A PRINCE OF CHIVALRY

Tales of King Arthur, his sword Excalibur, and the knights of his Round Table, are among the most stirring of all stories of the age of chivalry.

ARTHUR, KING. Among legends the world over, none so vividly reveals the age of chivalry and knighthood as does the story of King Arthur and his Knights of the Round Table, who lived in the sixth century. Ever since the legend of this brave king of Britain became a part of our literature, boys have hoped to be as bold as Arthur and his knights, and girls have secretly wished for the charm of Guinevere, his lady fair.

Arthur was born a prince, but a wise man of his father's castle, known as Merlin, persuaded the king and queen that their son would be safer elsewhere. Merlin

spirited the infant prince to the palace of Sir Ector, a kind and generous lord, who raised Arthur as his own son.

Eventually, the old king became very ill. Summoning his lords to his side, he ordered that upon his death his son should claim the crown and be made king. Nobles from the far corners of the land thereupon presented themselves as the rightful heirs, but it was only when Arthur, of all the men in the land, was able to pull the sword Excalibur from a rock, that he proved himself to be the true king.

Upon his marriage to the beautiful Guinevere, Arthur established his Knights of the Round Table, who, each year, at the Feast of Pentecost, vowed to be kind, brave, and loyal, and above all, to be chivalrous to ladies. The sword Excalibur remained at Arthur's side throughout his lifetime, and with it he won many battles. The king was slain while fighting against rebellious knights led by his nephew, Modred.

Stories of King Arthur and his knights have appeared in many languages. The best-known English version is Alfred Tennyson's poem, *Idylls of the King*.

ARTICHOKE. There are two different plants bearing this name—the French or globe artichoke and the Jerusalem artichoke. Of the two, the French artichoke is better known to Americans, but it is much more widely used in France than in America. It is a thistle-like plant bearing long, prickly leaves.

The base of the unopened flower bud and the fleshy leaves which enclose it are the parts eaten. The buds are sometimes eaten raw, but are usually parboiled in salted water until tender. At the table the leaves are pulled off and dipped in melted butter or other sauce. In America the commercial crop of French artichokes comes mainly from Southern Louisiana and California.

The Jerusalem artichoke is a species of sunflower that bears edible tubers not unlike potatoes. These are used both as a table and a stock food.

ARTICLE. We probably use the words *the*, *a*, and *an* oftener than any other three words. They are parts of speech called articles, and are known in general as *limiting adjectives*. *The* is called the *definite* article, and *a* and *an* are called the *indefinite* articles. *An* has the same meaning as *a*; it is used only before vowel sounds. See **ADJECTIVE**.

ARTICLES OF CONFEDERATION.

See **CONFEDERATION**, **ARTICLES OF**.

ARTIL'ERY.

"Over hill, over dale,

As we hit the dusty trail,

And the caissons go rolling along!"

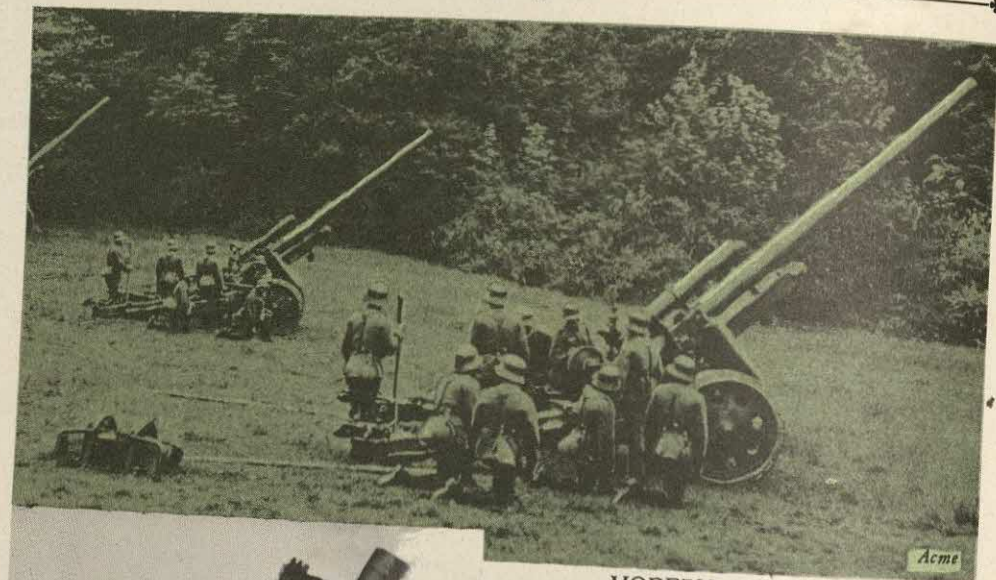
—From a Ballad sung by U. S. artillerymen during World Wars I and II.

Big guns, and soldiers especially trained to handle them, make up the artillery of the modern army. In military circles, the word is used to designate either the equipment employed or the organization of officers and men composing this essential branch of the service.

The Job of the Artillery. There are two functions for the artillery in modern warfare—to prepare the way for an advance, and to check advance by the enemy. In attacking, the artillery may lay down a *barrage* that rolls steadily toward the enemy, permitting the infantry to advance behind its protection. Another form, the *box barrage*, shells enemy reinforcements on all sides, preventing them from reaching the front or retreating.

During World Wars I and II, the armies used both long-range bombardments of enemy fortifications and short, fierce, concentrated fire, both with great effectiveness; the latter was used especially to weaken enemy positions and to prepare the way for an advance or an invasion by land troops.

Defensively, the artillery can stop an advancing force by the use of shrapnel and gas shells. Bombardments of hostile gun positions, railroads, bridges, supply depots, and transportation and communication facilities also serve to check the enemy. The anti-aircraft gun is used to hin-



MODERN ARTILLERY

Above, German artillery in action on the Western Front in World War II. The location for these guns was planned by army engineers in the forest clearing. The woods provide a perfect cover for the men and guns. Left, a modern twelve-inch mortar, which has just been fired. Note the steep angle at which the gun released its projectile.



der airplane mapping and observation. Small-caliber armor-piercing shells are used to halt tanks.

Organization and Personnel. Artillery organization is based on the *battery*, corresponding to a *company* of infantry or *troop* of cavalry. The battery usually consists of four guns and their crews, with supply, ammunition, and other services, requiring, in all, five officers and about 125 men. Six batteries compose the *regiment*, and three regiments form a *brigade*. One brigade of artillery is assigned to a line division of the army, together with two brigades of infantry and other special units.

Types of Equipment. Death-dealing, costly guns of modern armies are the de-

scendants of the old brass, wood, and iron cannon which came into use in the fourteenth century shortly after gunpowder made its appearance in Europe. These guns fired stones, iron balls, or chain shot, and frequently caused considerable damage, yet the best of them could not begin to compare with the various heavy arms of present-day artillery.

In modern *field artillery* are the light guns and howitzers, such as the 75-millimeter howitzer; the medium weapons, including the 4.5-inch gun and the 155-millimeter howitzer; and the heavy weapons, such as the 8-inch gun and the 240-millimeter howitzer. Some of these weapons are self-propelled, while others are drawn by trucks and tractors. The 75-millimeter howitzer shoots a projectile weighing less than fifteen pounds a distance of about 9,600 yards, while the 240-millimeter howitzer hurls a 360-pound projectile more than 25,000 yards. Rocket launchers may be included among artillery pieces in modern warfare.

Heavy artillery includes guns over six inches in diameter. These comprise the howitzers, which have proved to be very effective pieces; and large mortars and siege guns. These heavier, longer-range types are placed behind the lines and are used to destroy fortifications as far as ten miles behind the enemy lines. Anti-aircraft guns fire a shell on a nearly vertical line, and are equipped with sensitive and delicate instruments which allow the gunner to gauge the movements of a fast-moving plane.

Huge guns, although they cannot be moved around as fast as lighter pieces, are valuable to an army in several ways. It was shown in the First World War that the blast caused by the explosion of one shell from a long-range gun of the American army would cause more damage than many shells from smaller guns. These

huge guns, firing shells weighing 2,400 pounds, were mounted on railroad cars. The great German "Big Bertha" gun could fire a shell seventy-six miles to Paris, but did not cause great destruction. The gun was used principally to spread fear among the citizens of the French capital. Such large guns are usually assigned to an *army corps* or group of divisions.

Guns similar to those mounted on railroad cars are used for the United States coast defense. They are mounted on special bases at strategic posts along the coasts, can fire twenty-one miles, and may be hidden from planes by camouflage.

In order to make anti-aircraft artillery more effective, the Allies in World War II used a radar device that located approaching enemy planes and automatically directed the huge guns against them. See CANNON; HOWITZER; MORTAR; RADAR.

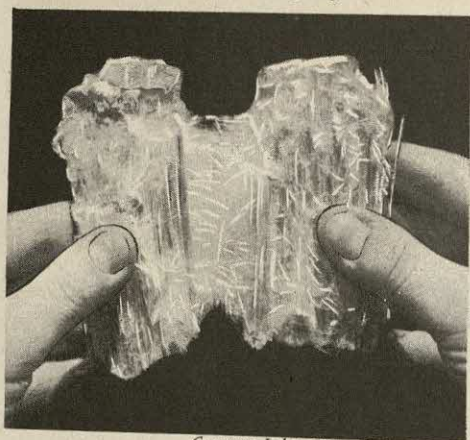


Acme Photo

THE BIG GUNS ROAR IN THE HILLS OF KOREA

An American gun crew reloads an eight-inch howitzer in the United Nations action against Communist aggression in Korea. The heavy shells blast enemy strongholds on the distant hillside.

ARYAN, *ahr' yan*. One branch of the human family is known as Aryan. It is now believed that the Aryans originally lived in the steppes of Southern Russia. These people later became the ruling race of India and Persia and, finally, of Europe. The term Aryan is often used to include only that branch of the human race whose early language was Sanskrit; the terms Indo-European and Indo-Germanic are then used in the broader sense. The word Aryan is also used to designate the languages of the many Aryan peoples. The modern European languages have grown from the early Aryan languages.



Courtesy Johns-Manville Int'l Corp.

THE QUEEREST OF ALL MINERALS

Asbestos is a heavy rock, yet it can be separated into threads and woven into a fireproof cloth.

ASBES'TOS. One of our most useful minerals is a fibrous substance that can be woven into fireproof cloth. It is called asbestos, a name that comes from a Greek word meaning *unquenchable*; for the quality that makes asbestos most valuable is its resistance to fire. It also resists acids and electricity. Wealthy Romans are believed to have been the first to use asbestos in cremation. By wrapping the bodies in a cloth made from this mineral, they saved the ashes of their dead. The Romans mined the heavy, fibrous rock in their native Italy. They separated the fiber by hand and combed it into fluffy thread from which to weave their cloth.

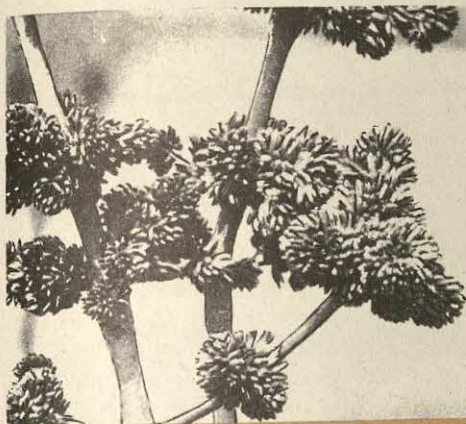
Although asbestos was known in ancient times, our present commercial production of it did not begin until late in the nineteenth century. Near Quebec, in Canada, where nearly four-fifths of the present world supply is taken, a mine was opened. There followed discoveries of asbestos in California, Wyoming, Vermont, Georgia, Maryland, Idaho, Washington, and Arizona, in the United States. Asbestos is also mined in Africa, Russia, Rumania, Australia, and Japan.

Asbestos varies from place to place and includes any one of three different minerals, all with different degrees of the important fire-resisting, acid-resisting qualities. Asbestos varies, too, in its form: it may be loosely deposited like flax or silky wool, or it may be compact and hard, easy to polish. Sometimes it is delicately thread-like and elastic, shining like glass; or it may be found in the earth as short-fibered flakes.

In any form, asbestos has a use. When it is of the fibrous variety, the heavy rock can be placed before a jet of air which separates the fiber. Then it is carded like wool, combed first by coarse and then by fine teeth, until it can be spun into thread and finally woven into cloth or fabric. Such cloth provides fireproof theater curtains and heat-repelling gloves for workers in flaming steel and glass furnaces.

Fine, strong wire can be woven with the asbestos to give it strength; with tar and strong canvas it can be used for fireproof roofs on factories and homes; with grease it furnishes fireproof packing around fast-running shafts in locomotives, gasoline engines, or any other machinery; with rubber it is woven around wires carrying electricity, thereby insulating them. Asbestos can be made into moving belts to carry flaming coal. It is also made into brake lining which does not burn when it grips the wheel. Moreover, asbestos provides a filter for powerful chemicals; the acids can be safely strained through its mesh.

When the fiber cannot be woven, a good



THE TREE FROM WHICH BASEBALL BATS ARE MADE

Noted for its light, tough wood, the ash (left) is one of the few trees which have leaves set oppositely on the twig. Lance-shaped winged fruits (right) spin from the ash in fall and winter, sometimes carrying the seeds long distances.

many uses are found for matted, pressed, or felted asbestos. It can be finely ground for filler in paints. Ground asbestos is used in millboard, polished tile, shingles, and other building materials. It is fluffed into old walls to insulate them against summer heat and winter cold; it is mixed with new plaster to make a fireproof wall covering.

It is probable that one cannot see a single article in our modern world which does not at some point in its manufacture owe a debt to asbestos—resistant to heat, to chemicals, and to electricity.

ASH. The wood of this tree goes into the making of many articles in common use. One of the most familiar of these is the baseball bat, and when we think of what is needed in a baseball bat, we have the characteristics of ash wood. There is needed a wood that is light, strong, not brittle but tough, and not easily broken by sudden strains. Ash meets all of these requirements, and so is used also for making tool handles, wagon spokes, furniture, oars, and many other objects.

Ash trees are tall, clean-cut trees with distinctly opposite branches. They reach a height of from 90 to 120 feet and are shallow-rooted. Ash trees are quite commonly planted for shade because of their beauty, but they make an undesirable amount of clutter on the ground when the

leaves fall. The fruit of the ash is provided with a wing at one end. This sets the fruits spinning when they become freed from the tree and helps in carrying them for long distances.

The white ash is common on hillsides in mixed forests in Eastern and Central North America. Other well-known species are the *red* ash, a medium-sized tree, and its variety the *green* ash; the *blue* ash, a tall timber tree of the Mississippi Valley; and the *black* ash, slenderest of forest trees, found from Newfoundland to Manitoba and south to Virginia and Arkansas. Ash trees belong to the olive family.

ASH WEDNESDAY. There used to be a custom, in the Western Church, of sprinkling ashes on the heads of people who desired to repent of their sins. This was done on a Wednesday, the first day of Lent, a Christian fast which lasts until Easter. From this observance the first day of Lent has come to be called Ash Wednesday. The custom is said to have begun with Pope Gregory the Great. Today, in the Roman Catholic Church, the ashes are consecrated on the altar and sprinkled with holy water; then the priest makes the mark of the cross on the foreheads of the clergy and people, saying in Latin, "Remember that thou art dust and unto dust thou shalt return."

Where Half the World Lives— ASIA



ASIA. Largest of the continents, mother of most of the earth's peoples, cradle of earliest civilizations, and now home of over half the total population of the world, Asia is truly the most remarkable of the continents of the globe. A colorful history, reaching far into the past, widely different races of people, and great extremes of geography and climate, all lend interest to the study of this vast continent.

Asia is five times as large as Europe and more than equals the combined areas of North and South America. Its greatest east-to-west length is approximately 6,800 miles, and its distance from north to south is about 5,300 miles. Europe is in reality but a great westward-stretching peninsula of Asia, the two continents being separated only by the Ural Mountains and by a depression in the surface, extending from the mountains to the Caspian Sea. To the southwest of Asia lies Africa. On the northeast the westernmost tip of North America, the Aleutian Islands, almost touches Asia's most easterly extensions.

Ocean and Sea Boundaries. The shores of Asia are washed by three oceans—the Arctic on the north, the Pacific on the

east, and the Indian on the south. Half a score of seas help to form further boundaries of the continent; for the coasts of Asia, unlike those of Africa, have deep indentations, some of them so large that they form great seas like the Bay of Bengal and the Arabian Sea. Consequently Asia has a coast line of about 33,000 miles. Its area is about 17,250,000 square miles.

Numerous islands and archipelagos dot the seas about Asia. A few have become as important as some of the countries on the mainland; among these islands and groups of islands are Japan, the Philippines, Java, Borneo, and Sumatra.

Geographical Opposites. So far as physical features are concerned, the extraordinary is the rule in Asia, rather than the exception. On this continent is found the highest peak in the world—Mount Everest—rising more than 29,000 feet above sea level. There, too, is the deepest depression in the earth's crust—the Dead Sea—approximately 1,300 feet below sea level. Asiatic lands have the most intense heat and the most bitter cold. There are plateaus so high that they carry the name "roof of the world"; there are plains so far-reaching that they seem endless. In Asia is fertile soil that needs but to be



Black Star; Triangle Photo Service



WOMEN OF EAST AND SOUTH ASIA
Japanese girl (upper left) wears ceremonial dress and traditional "hair-do." Hong Kong woman (above) poles boat on river. Mongolian bride (right) wears her dowry.

scratched with a stick and seeded to bear plentiful harvest; yet there are vast sterile stretches where the hardiest weed cannot grow.

These are but a few of the extremes that characterize this giant among the continents.

Asia's Surface and Climate. Northern Asia is a plain, threaded by great rivers. But the lack of moisture and the shortness of the growing season make much of it a dreary waste. Inner Asia, which includes Tibet, Mongolia, and Chinese Turkestan, is high—a plateau-and-mountain region, with little rainfall and violent extremes of heat and cold. At the southern edge of this region is the highest mountain range

in the world, the towering Himalayas, which include several of the world's highest peaks. The eastern section of the continent has a more varied surface, with fertile plains, and mountains which frequently yield crops to their very summits.

Of course, in a section of the world stretching through so many degrees of latitude, the climate shows marked variation, ranging from the great extremes of heat and cold in the Siberian lowlands and Northern China, through the dryness of the vast regions in the center of the continent distant from the sea, to the tropical conditions in the south. Everywhere in the eastern region there is sufficient moisture for agriculture, and in some localities in Southeastern Asia there is the heaviest rainfall known anywhere in the world. In Assam, Northeastern India, the rainfall averages over 400 inches, or about thirty-five feet, a year.



STAIRCASE TO A SIDE STREET

Hong Kong's bustling downtown crowds reach many streets by climbing steps.

Great rivers, too, traverse Eastern Asia, notably the Hwang Ho and the Yangtze Kiang, which with their overflow, fertilize a wide territory. Extreme Southern Asia has few mountains of any height; but it has plenty of rainfall and an exceedingly fertile soil, with such great rivers as the Ganges, the Indus, and the Brahmaputra. However, the tropical climate has had the usual weakening effect, and no strong, independent nations have developed in Southern Asia.

Western Asia is dotted with lakes and inland seas, chief of which are the Caspian Sea, the Aral Sea, Lake Balkhash, and the Dead Sea. They have no outlet to the ocean, but are fed by various rivers. The chief body of water in Eastern Asia is Lake Baikal in Southern Siberia, the largest fresh-water lake in Europe or Asia and the deepest in the world.

Vegetation. Asia possesses almost every

type of vegetation, from pines and tundra mosses in the extreme north to palm, teak, and rubber trees, sugar cane, rice, and cotton in the south. In the mountain regions of Inner Asia the same gradation of plant life is seen, but here the determining feature is altitude instead of latitude. Rice is the distinctive product of any part of the continent where it can be grown, especially in the southern and much of the eastern parts; and in sections of Southwestern Asia the date and other varieties of palms often constitute the entire wealth of the inhabitants. In addition to rice and cotton, India and China cultivate wheat, barley, tea, coffee, indigo, opium, tobacco, and maize extensively.

Asiatic Animals. Asia was the original home of most of the domestic animals—the ox, the horse, the ass, the sheep, and the goat; and Arabia still produces the finest



Unations

BURMA CERAMIC WORKS

A Twante village potter puts a finishing glaze on one of his products.

horses in the world. Besides these, certain other animals have been domesticated in the various sections: the water buffalo in Southeastern Asia, the elephant in India and Burma, the camel in the central lowland, and the yak on the plateaus of Tibet.

There are few kinds of wild animals which are not to be found somewhere in the jungles or the mountains or the rivers; the tiger, the lion, the bear, the deer, the



rhinoceros, the wolf, the crocodile, and the endless varieties of monkeys are some of the well-known wild creatures.

Mineral Wealth. Of minerals Asia has a great store, though much of this wealth is still undeveloped. Southern Asia yields precious stones, such as diamonds, sapphires, and rubies; the Malay Peninsula, with its islands, has rich tin mines; China, given better transportation facilities, could produce enormous quantities of coal; and the Ural Mountains yield platinum.

Asia's Millions. More than half the people of the world live in Asia. It is estimated that the population is about 1,700 millions, and the total world population is about 2,850 millions. In the northern part of Asia there are vast stretches where no one lives, and other stretches where the inhabitants are widely scattered; but at places in the south and east the people are crowded together in a way that seems almost suffocating to dwellers in Western lands.

The inhabitants of the eastern part of the continent, which includes China, Japan, Indo-China, and Siam, belong to the yellow race; that is, they are Mongols. In the

north, also, the Mongol race predominates, but the climate and conditions of life are so different that the two groups show little similarity. Southern Asia presents a greater variety in population, no fewer than 140 languages or dialects being spoken in that section of the continent. There are Aryans, who belong to the white race; Mongols; Malays, who are of the brown race; and several groups which belong to the Negro race. Nowhere else in the world, perhaps, can there be found such a mixed, many-languaged population.

Southwestern Asia has, in centuries gone by, touched the life of Europe most closely.

EAST MEETS WEST IN ASIA

Left, a large modern reservoir to provide electrical power for China's industrial development. Right, Korean children—two in the country's traditional quilted clothing and the third in a modern coverall and ballet-type slippers.

Eastfoto



Kulwant Roy

DANCERS TELL TALE OF INDIA

Many of the different peoples of Asia are noted for colorful dances that are a part of the tradition of the country. Today trained dancing troupes perform these dances for audiences in other countries. With brilliant costumes and graceful body movements and hand gestures a troupe from India portrays a story about Lord Krishna, his wife, and a gopi (servant girl).

This section is peopled mainly by a brown-skinned race, although it also has representatives of the white and yellow races. Here, however, these different peoples are held together by at least one common interest—all are Mohammedans.

It is interesting to note in connection with the people of Western and Southern Asia that, although most of them are said to be of the "brown" race, they are really no browner than are many southern Europeans, like Spaniards or Italians. Of course, compared with the blond Nordic race of Northern Europe, they seem very dark. The natural color of their skin becomes even deeper with long exposure to the sun; it seems to be especially suited to the climate, for these people are able to withstand heat and glare from the sun that

would be fatal to the fairer people of the north.

The chief occupation of the people in Eastern and Southern Asia is agriculture. However, China and Japan, especially Japan, with its excursions into China, India, and the Philippines, have in recent years developed large manufacturing interests. Throughout the rest of the continent the people are in many places dependent on their animals—the horses of Arabia, the camels of Turkestan, the yaks of Tibet. Many of the dwellers in the more desolate interior sections are nomads, possessing little more than enough to keep them alive from day to day.

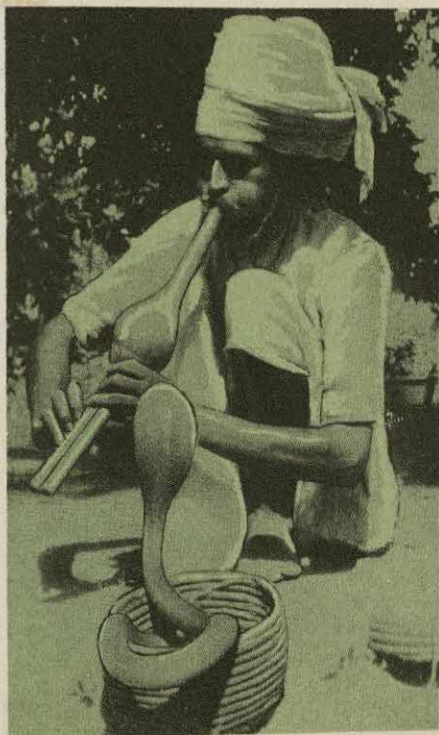
Most of the great religions of the world have come from Asia. Western Asia is the birthplace of the three principal faiths of the entire Western World—Christianity, Judaism, and Mohammedanism. In the south and east the principal religions are Buddhism, Confucianism, and Shintoism, practiced in India, China, and Japan, respectively. These six outstanding faiths are quite similar in their ideals, but they differ greatly in their methods of worship.

The Cradle of the Human Race. Asia is regarded as the birthplace of humanity, for it possesses the oldest historical documents in existence and, next to Egypt, the oldest historical monuments. Even though the earliest narrative records of any nation, those contained in the Old Testament of the Bible, date back little further than 1500 B. C., it is known that great civilizations existed long before then in Babylonia and Assyria, between the Persian Gulf and the east end of the Mediterranean. Egypt, too, had a civilization of its own in those days.

One of man's earliest homes was probably in the valley of the Tigris and Euphrates rivers, which run southeast toward the Persian Gulf. From there men emigrated to the southeast and southwest, finally occupying Northern India, Persia, and other parts of Western Asia and spreading into Europe. The history of China dates from about 2000 B. C., but there are legends which cover a long period preceding this date.

The political history of Asia probably began in 559 B. C., when Cyrus the Great and his son Cambyses extended the Persian Empire westward to the Mediterranean and southward to include Egypt and Libya. The empire of Cyrus later came, in turn, under the control of Alexander the Great and of the Romans. The birth of Christ in Western Asia occurred about the time that Roman power reached its height.

During the seventh century after Christ, the Mohammedans extended their sway over Persia and Syria and part of Egypt. In the year 1000 India was conquered by the Moslem Mahmud. At about the same time the Turks had moved west to the Mediterranean Sea; a little later they became involved in war with the Crusaders. During this period, a Mongol chieftain named Genghis Khan had made himself master over Central Asia and had conquered Northern China and Turkestan. Stories of his life and conquests can be found in many books today. The Mongols later overran all Northern and Western



SNAKE-CHARMING: A RISKY ART

Fascinated by the weird music and motions of the fakir, the deadly snake slowly sways to and fro.

Asia, including the Turkish Ottoman Empire founded in 1300. In 1453, however, the Mongols were expelled, and the Ottoman Empire recovered its prestige.

Siberia was conquered by Russian Cossacks late in the sixteenth century, although settlement of the land did not begin until about a hundred years later. The land has remained under Russian control since then. Vasco da Gama, Portuguese explorer, sailed to India in 1498. Many European nations then began to establish settlements and trading posts along the Indian coasts or on the neighboring islands. India came under the control and influence of Great Britain in the nineteenth century, and France later gained control of Indo-China. Germany was unsuccessful in her attempts to get strong footholds in China and other Asiatic countries, but Russia was able to take over rich territories in Siberia and adjacent lands to the south.



ASIA'S BEASTS OF BURDEN

Sacred white oxen pull the carts in the Federation of Malaya (upper left). The hairy yak toils on the plains of Central Asia (above). Large Indian elephants are used for performing heavy tasks (upper right). Desert travel is conducted on the Bactrian camel.



Japan annexed Korea in 1910, and conquered Manchuria, and northern and central China in the 1930's.

In western Asia, after World War I, Turkey lost its holdings in the Arabian peninsula. Armenia became a Soviet republic. After World War II, Japan lost its Chinese territory and Korea. China, India, Burma, Indonesia, the Philippines, and Japan were battlegrounds of World War II. The war strengthened the desire of colonial peoples for their independence.

Political Divisions. Eighteen new Asian nations became independent after the war. By 1960, the possessions of European powers in Asia had dwindled to a few British and Portuguese holdings. Communism became a major force in Asia; the large country of China became Communist. Independent nations of Asia are given below by regions.

Dates of independence are given for those countries that became independent after World War II.

Southwestern Asia: Turkey, Iran (Persia), Iraq, Saudi Arabia, Yemen, Muscat and Oman. Syria and Lebanon (1946), former French League of Nations mandates, and Transjordan (Jordan), former British League of Nations mandate. Israel (1948), former British mandate. Cyprus (1960), former British colony. In 1958, Syria joined with Egypt to form the United Arab Republic. Aden, Kuwait, Bahrain, Qatar,



WILD CREATURES OF THE ASIATIC CONTINENT
 Upper left, a baby orang-utan, ape of Sumatra and Borneo.
 Lower left, polar bears of the north coast, in the Arctic Circle. Above, the fierce tiger which roams the jungle of Central Asia and India. Below, the Panda, strange, rare beast of Tibet.

and the Trucial States are protectorates of Great Britain.

Northern Asia: United Socialist Soviet Republic (Russia).

South Central Asia: Afghanistan, Nepal. The large country of India, long a rich colony of Great Britain, was divided in 1947 into two independent nations, India (Hindu) and Pakistan (Moslem). They are members of the British Commonwealth. See BRITISH COMMONWEALTH OF NATIONS. In 1949, India became a republic, and Pakistan in 1956. In 1948, Ceylon became independent within the British Commonwealth.

Bhutan is an Indian protectorate. The island Goa, off west India, is Portuguese.

Eastern Asia: After the war, China received back Manchuria, Formosa, and other provinces from Japan. In the west, the People's Republic of Mongolia, proclaimed in 1921, is recognized by Soviet Russia and Red China. By 1949, Communist forces under Mao Tse-tung had control of all continental China and proclaimed the People's Republic of China. The Nationalist forces under Chiang Kai-shek withdrew to the island of Taiwan (Formosa).

Korea was divided into North Korea

(Communist) and South Korea in 1948. In 1950 North Korean troops invaded the Republic of South Korea. United States, together with other United Nations, immediately sent military aid and fought until 1953. This was the first war fought under the United Nations flag. In Japan, American occupation, which began after World War I, ended in 1952. Off southeast China is the city of Hong Kong, a British colony and one of Asia's most important ports, and the Portuguese island of Macao.

Southeast Asia: Thailand (Siam). The Philippines (1946), former part of the United States. Burma (1948), former British colony, left the British Commonwealth. Indonesia (1949), former Netherlands colony on the Malayan archipelago of islands off southeast Asia. After an eight-year war, France granted independence to Cambodia in 1953, and Laos and Vietnam in 1954. Later in 1954, Vietnam split into North Vietnam (Communist) and South Vietnam. South Vietnam became a republic in 1955. Federation of Malaya (1957), now a member of the British Commonwealth, on the Malayan peninsula. The British crown colony of Singapore became self-governing. Great Britain has the colonies North Borneo and Sarawak, and protectorate Brunei in northern Borneo. Portugal owns the eastern half of the island Timor in the Malayan islands.

Further information may be found in articles on Asia's important political subdivisions. See also:

Arabia	Himalaya
Assyria	Hwang Ho
Babylonia	Indian Ocean
Brahmanism	Jerusalem
Buddhism	Mohammedanism
Caspian Sea	Palestine
Christianity	Persian Gulf
Confucius	World War I
Dead Sea	World War II
Genghis Khan	Yangtze Kiang

ASIA MINOR. The most westerly peninsula of Asia is called Asia Minor. Roughly, it lies west of the upper Euphrates River and extends to the Mediter-

anean Sea. Its area is over 200,000 square miles, more than twice that of Wyoming.

Called Anatolia today, as well as Asia Minor, the country was divided into fifteen sections in ancient times, including Pontus, Paphlagonia, Bithynia, Mysia, Lydia, Caria, Lycia, Pisidia, Pamphylia, Cilicia, Isauria, Cappadocia, Galatia, Phrygia, and Lycaonia. At the close of the First World War, the Ottoman Empire was broken up, and modern Turkey was formed, partly in Asia Minor. Today the peninsula is divided into a number of Turkish provinces, with a population of 27,000,000. Nearly 26,000,000 of the people are Moslems. See **TURKEY**.

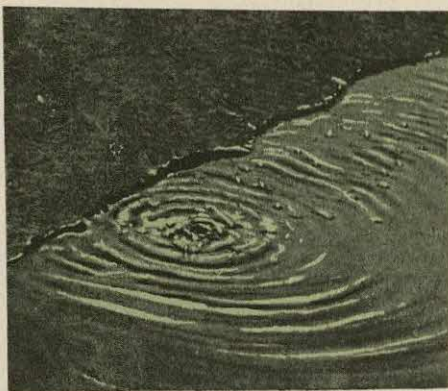
ASPARAGUS, *as par' a gus*. Chief among the plants that bear this name is the well-known garden vegetable whose tender young shoots are so delicious in early spring. There are several related species grown for ornament. Among these is the so-called asparagus fern, a house plant with beautiful lacy leaves. All forms belong to the lily family.

The vegetable asparagus can be grown successfully in the home garden if care is taken to have the soil well drained, well fertilized, and thoroughly tilled. The ideal soil is a rich, deep sandy loam.

The plants should be allowed to grow three years from the seed before they are cut; after that, for ten or twelve years, they will yield a regular yearly supply. The young shoots should be cut soon after they come from the ground. In winter the plant beds are protected by straw or litter. When the blanched (whitened) product is desired, the soil is ridged over the rows at the start of the cutting season.

Asparagus is valued for its wholesomeness and flavor. While its actual fuel value is low, it gives savor to other more nutritive foods, as when used in cream soup, or on toast with a cream sauce. Large quantities of asparagus are canned.

ASPEN, or **TREMBLING POPLAR**. This interesting tree is found from coast to coast in Canada and the United States. It grows rapidly, reaching a height of 130



Courtesy Johns-Manville Int'l Corp.

FROM POND TO PAVEMENT—ASPHALT

This black, sticky mineral is found chiefly on the island of Trinidad, where it actually forms a lake, 114 acres in area (right). It is also mined as a hard material called gilsonite, in Utah.

feet, and is valuable in quickly reforesting mountain slopes and areas from which other trees have been removed by fires and lumbering. The leaf blades are small and heart-shaped, and are supported on long, flattened stems so slender that even a faint breeze causes them to sway back and forth with a trembling motion. When young the trees have an attractive white bark, and the light, soft wood is useful for making paper pulp, bowls, crates, trays, pails, and charcoal. A closely related species is found in the mountainous regions of Europe and Asia.

ASPHALT, *as'falt*. If you have ever felt your heels sink into the rubbery surface of the street on a hot day, you have been walking on a pavement covered with a black cushion of asphalt. Asphalt is a mineral found in a natural state either where it has welled up from the earth's mysterious interior, or in rock formation. It is related to those other valued products of nature—petroleum and natural gas.

Back in Bible times, men used a form of asphalt found in the Red Sea, to help build the palaces of Nineveh and the Tower of Babel. But these ancient builders had no notion of the dozens of uses we have found for this material today. We coat the roofs of our houses so that winter rains cannot beat through. We mix asphalt with crushed stone to surface the roads that

carry us to market, to church, to school. We put a compound of asphalt in varnish. We coat our wooden fishing ships with it to protect them from boring worms.

More important than any of these uses is the employment of asphalt in building streets and roads. Today the United States has thousands of miles of asphalt roadway, and three-fourths of the asphalt thus used has come from one place—Trinidad. In fact, while asphalt has several names, including *Jews' pitch* and *Dead Sea bitumen*, it is frequently called *Trinidad bitumen*.

Trinidad is an island close to the mouth of the Orinoco River, off the coast of South America. On this island is a mysterious lake—in reality the deep crater of some old volcano. This deep hole is filled with black, glossy "pitch." It is the famous "asphalt lake" whose depths have never been plumbed beyond eighty feet, and whose supply of asphalt seems inexhaustible. Like the milk in the Miraculous Pitcher of legend, no matter how much of the liquid is taken out, more wells up from the bottom. Overflows of the material have spread out over the surface of the shores, and, becoming brittle, are mined like veins of soft coal.

The Trinidad asphalt is mined in a strange way. South American natives with pickaxes mine chunks of it before daylight while it is still brittle in the cool air. These

glossy brown-and-black chunks are loaded on small flat cars carried on a narrow-gauge railway, which is actually laid on the surface of the lake. Palm branches form the roadbed for this tiny railway, in order that the rails will not sink into the viscous mass beneath. The buckets of material are hoisted by a continuous cable to the very hold of a ship waiting in the harbor. The cargo loaded, the ship steams away for the ports of the world.

Lake Bermudez, also in South America, is another source of supply.

Asphalt is also found in veins or cracks of limestone; in fact, there are such deposits in California and Utah, but the amounts found in America do not begin to supply domestic needs, and Americans must buy from their South American neighbors. Asphalt cannot be used in its natural state, but must be refined or purified. The amount of refinement depends upon the use to which the crude asphalt will be put. Road asphalt can have a great deal of foreign material. The refining process usually takes place in the country to which the asphalt has been shipped.

ASS. This relative of the horse and the zebra has served mankind faithfully for thousands of years. The ass is a valued beast of burden in many parts of the Old World, but in America it is used chiefly for breeding purposes in the production of mules. For these useful animals are a cross between the male ass, or jack, and the female horse, or mare. The female ass is called the jennet. Asses, male and female, are sometimes called donkeys.

Asses are found wild in Asia and Africa. From an early date the domesticated ass has been produced and used in Western Asia, Southern Europe, and on some of the islands of the Mediterranean Sea. It is probable that various breeds of these animals were brought to America by the early Spanish explorers and settlers, but their production and use in the United States were not important until the beginning of the nineteenth century.

The ass lacks the grace, symmetry,

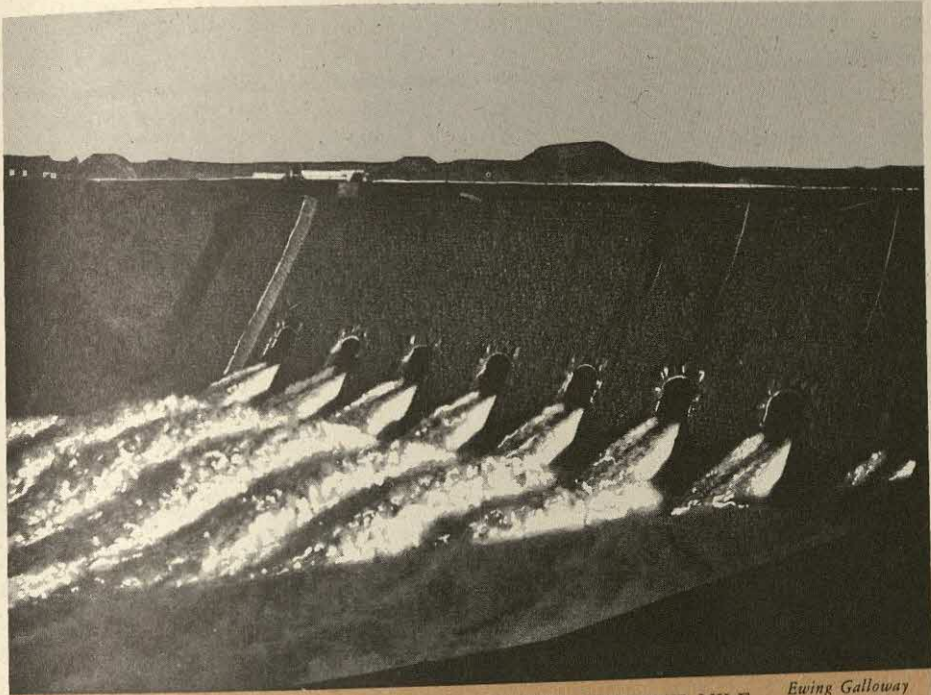
smoothness, activity, and style of the horse. Its head is large, with deeply set eyes and large, long ears, and it is joined to the body by a neck that is apt to be unshapely. Yet the patience, caution, and hardness of the ass give it value. It is noted for its ability to subsist on the coarsest food, even when found only in small quantities. The milk of asses is nourishing, and in some parts of Africa large herds are kept solely as milk animals. See HORSE; MULE.

ASSAY'ING. Gold as it comes from the mines is by no means the glittering yellow metal we see in coins and jewelry. It is mixed with other minerals and impurities from the earth. Not even is it the right color. In order to determine the value of this hidden precious metal, chemists have devised processes called assaying. There are two different systems, both very complicated, but both reaching the same end—determining the value of substances containing gold.

These chemical processes are conducted in so-called assay offices, controlled by national governments. In the United States, assay offices are located at New York City, Denver, Colo., Boise, Ida., Carson City, Nev., Helena, Mont., Deadwood, S. D., Seattle, Wash., New Orleans, La., and Salt Lake City, Utah. People who have gold ore, or gold-plated tableware and jewelry, take the metal to the assay office, where a sample of it is tested by the chemist. The offices also assay silver in a similar way.

Though assay offices are operated by the government, no coins or bills are made there. Coinage is confined to the mints, and paper money is made at the United States Bureau of Engraving. See MINT; COINS AND COINAGE; METALLURGY.

ASSUAN, or ASWAN, *ahs swahn'*. Situated in Southern Egypt on the east bank of the Nile, Assuan has come down from antiquity. In times of peace it was the depot through which caravans passed on their way to the Sudan and Abyssinia. Near the town are the famous old quarries from which the Pharaohs in early days obtained granite for obelisks and statues.



MODERN IRRIGATION FOR THE ANCIENT NILE

Ewing Galloway

A mile and a quarter long, the great Assuan Dam in Egypt holds 523,000 million gallons of water, affecting the volume of the Nile River for 174 miles. It was built in 1902, and enlarged twice, now being 175 feet high and having 123 sluice gates.

Here in 1902, Great Britain built the Assuan (Aswan) Dam, an irrigation marvel of its time, which watered 1,500,000 acres of thirsty Egyptian land. In 1960, the United Arab Republic, with Russian engineering skill, began building the colossal High Aswan Dam. It was planned to be 365 feet high, 3.1 miles wide, and to back up the waters of the Nile into a lake 400 miles long, irrigate 2,000,000 more acres of land, and produce 10 billion kilowatt hours of electricity yearly. See IRRIGATION.

ASSUMPTION, *as sump' shun*, FEAST OF THE. One of the miracles associated with Christ is the transference to heaven of the soul and body of the Virgin Mary, by Christ and the angels. The Christian festival that honors this miracle is called the Feast of the Assumption. It is observed on August 15 of every year by the Roman and Greek Catholic Churches. Several great paintings picture the story of the Assumption. Among these are the treatments by

Fra Lippi, Titian, Rubens, Perugino, and Murillo. See MARY, THE VIRGIN.

ASSYRIA, *a se' re ah*, was one of the two great ancient empires which flourished in the Tigris-Euphrates Valley in what is now part of the modern state of Iraq. Its rival for supremacy in that region was Babylonia to the south.

History of the Ancient Kingdom. According to legend, Assyria was founded by King Ninus and his beautiful queen, Semiramis, who was said to be the daughter of a goddess. However, Assyrian writings which came to light in the nineteenth century showed that the country was first settled by Babylonians who had journeyed north to the Tigris River basin at least 2,000 years before Christ. These people built a great city with sun-dried bricks and named it Assur, after their chief god.

Cruel and warlike, the Assyrians reached out for more land. In the reign of Tiglath-pileser I, about 1,100 years before Christ,



A STRANGE ASSYRIAN GOD

This winged, eagle-headed deity is carved on the wall of an Assyrian temple, recently excavated. Much of the history and culture of the people has been learned from the art in their buildings.

they overcame their Babylonian rivals and grew rich and powerful. Nineveh became the capital instead of Assur. As the armies of King Assurnazirpal pushed westward in the ninth century before Christ, conquering more countries, Nineveh became the leading city of the Eastern World. Syria and Phoenicia came under the power of the Assyrians, who ruled supreme in the world at that time.

Then for two centuries Assyria grew weaker and lost prestige, and Babylonia became stronger. In the eighth and seventh centuries before Christ, however, a strong ruler, Sargon II, restored the power of Assyria. He conquered the Babylonians, subdued the Hittites, crushed the Kingdom of Israel, and took many cities on the Mediterranean coast. The Eastern World again paid tribute to Assyria. Later, under the reign of Assurbanipal, Assyria ruled from the frontiers of India to the Aegean Sea.

When Assurbanipal died, the nations conquered by the Assyrians began to revolt. Succeeding kings were weak, and the people, grown fond of luxury, refused to go to war, and their provinces broke

away. Finally, in 612 B. C., the Babylonians under Nabopolassar overthrew their former rulers and took Nineveh. The country was divided between the Babylonians and the Medes, and Assyria sank into oblivion.

The Assyrians and Their Customs.

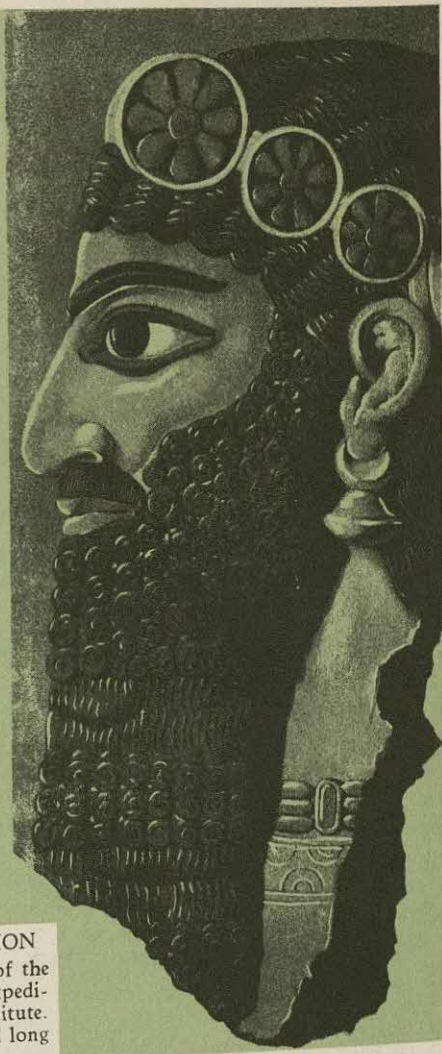
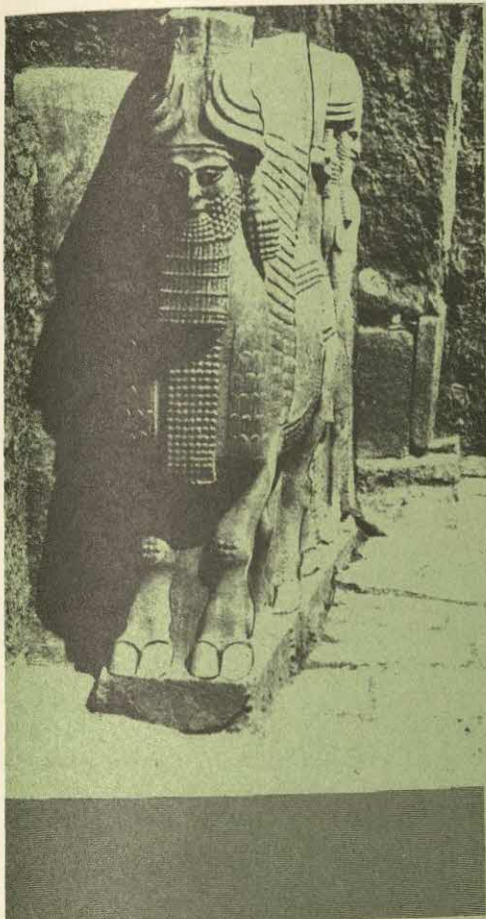
The Assyrians worshiped many gods who represented fire, water, sun, and other forces of nature. We know, too, that they developed a calendar. Their writing consisted of wedge-shaped marks made on clay tablets baked in the sun. Assyrian writing was not like the Egyptian hieroglyphics, since it had no pictures; it was called cuneiform inscription.

The Assyrians also had libraries consisting of shelves stacked with clay tablets. Tags hung from these unusual "books" indicated the titles. There were schools in the cities, and the members of the nobility were well educated, according to the times. The language was Semitic, similar to the Babylonian language.

The Assyrians were great builders and devoted themselves to beautifying their cities. Their buildings were square-shaped, and the temples were built much like the pyramids of Egypt, only not so high or so pointed. Using limestone quarried in the mountainous part of the country, they carved rugged statues of lions and human-headed bulls. They decorated their walls with figures and inscriptions. Around their cities they built huge, thick walls which proved to be a great protection in time of war.

The government, under a king, was well organized, and the Assyrians were able to hold their conquered people, when they were in power. During the early years of the kingdom, the people volunteered to fight; but later there was a regular organized army.

Wall carvings show that the court of the kings was brilliant and splendid. The rulers dressed in elaborate and expensive clothes. The throne was of carved ivory and gold; food was served in gold, silver, and bronze vessels. Wall decorations also show the kings riding in chariots to hunt



ART TREASURES OF AN EXTINCT NATION

Above, one of two stone figures guarding the gate of the Assyrian city of Khorsabad, unearthed by the Iraq expedition of the University of Chicago's Oriental Institute. All Assyrian men and their gods had full beards and long hair, as depicted on this rock fragment (right).

lions, and the army marching, waging battle, torturing prisoners, and capturing cities.

The Assyrians were great traders, and at the height of their power, Nineveh was very wealthy. We also know that some of the land along the Tigris was created artificially by piles driven into the water. One of the most remarkable customs of the Assyrians was transporting large groups of people from their native communities to the provinces. This was done to relieve overcrowded districts and to have people cultivate new lands.

Like many other nations of the ancient world, Assyria could not withstand the evils of too great wealth and luxury, despite her strength and power. Conquered, her people left the country or forgot their civilization. The great buildings and temples were destroyed and never rebuilt. The rivers overflowed the land, and, had it not been for man's curiosity, the story of Assyria might have remained a secret forever, hidden from the world by layers of silt. See BABYLONIA; NINEVEH; CUNEIFORM INSCRIPTIONS; ARCHAEOLOGY; TIGRIS; EUPHRATES.

ASTER. Blue, purple, white, golden, the starlike asters form a fitting climax to the succession of flowers that delight us from early spring to fall. Along roadsides and in woods and home gardens, the asters lend color and charm to the autumn landscape, when most of summer's flowers are gone.

These popular flowers belong to the composite family, composed of plants whose flower heads are made up of many small blossoms. Asters are related to chrysanthemums and goldenrods, which also are at the height of their beauty in the golden autumn days. The China aster is a showy species with a large brilliantly colored head that is truly a rival of the regal chrysanthemum.

A large number of the more than 200 species of aster are found in the United States and Canada. Among the commonest of the purple asters is the *New England*, which may be recognized by its clasping leaf bases. The *heart-leaved* occurs frequently in woods and thickets. Scores of American wild asters have been improved and admired in Europe as *Michaelmas daisies*. Asters are perennials of the easiest culture, and well repay the home gardener for the labor of planting and care. The flowers may be cut for use in large vases and baskets; well arranged, they add cheer and color to any room in the house.

ASTEROIDS, or PLANETOIDES.

Very small planets called asteroids, or planetoids—too small to be observed with the naked eye—revolve about the sun. The largest of those that have been measured is only about 485 miles in diameter, and the smallest from three to five miles. The combined mass of the asteroids is probably less than 1/500 of the earth's.

Most of the asteroids travel in varying paths between the planets Mars and Jupiter. Some stragglers, however, move hundreds of millions of miles farther away, and some come relatively close to the earth. At times Eros comes as close as 14,000,000 miles. This asteroid takes about two years to revolve about the sun, but some of those farthest away take about ten years.

Ceres was the first asteroid discovered—on January 1, 1801. Within the next six years others were seen and were named Pallas, Juno, and Vesta. At times Vesta, the brightest of them all, can be seen without a telescope. The fifth asteroid—Astraea—was not discovered until 1845, and after 1847 others were found. Now there are over 1,200, and more are being found every year. At first, astronomers sought the asteroids by scanning the heavens with their telescopes. After 1891, however, hundreds were discovered by the use of photography; astronomers today photograph them through telescopes much more powerful than those used years ago.

Because the asteroids are so very small and are found so close together, it was at first thought that they were the remains of a planet that had long ago exploded. Scientists are not agreed as to this theory, some having rejected it as improbable. Another theory is that each of the small planets was formed independently of the others. It has also been suggested that the asteroids might have combined to make one planet had there been a nucleus about which they could have formed. See ASTRONOMY.

ASTOR, JOHN JACOB (1763-1848). In the early years of the American nation, the greatest fur business of the time was developed by a German immigrant, John Jacob Astor. He was born in Walldorf, a village near Heidelberg, and his father was a butcher. At seventeen, John went to London, where he learned to speak English and made a living by working in his uncle's piano and flute factory. After three years he decided to try his fortune in America. Sailing in 1783, he arrived in New York with hardly a cent to his name. But the young man had plenty of courage and he knew something about preparing animal skins for the market. He went into the business, and by 1786 he was owner of a fur-trading store that proved very successful.

Astor was encouraged to branch out, and during the next few years he set up trading



A FUR EMPIRE IN THE WILDERNESS

Pioneer of America's early fur trade, John Jacob Astor amassed a great fortune.

posts from the Great Lakes to the Pacific Ocean. Ships carried his furs to faraway China and India. In 1811 he founded a central trading post at the mouth of the Columbia River, in Oregon, calling it Astoria. This was just before the War of 1812, and in 1813 the English captured the place. Though Astor finally lost his Oregon post, he was successful in other ventures, and made huge profits by buying land in and about New York City, at a time when real estate was cheap.

The once penniless immigrant boy was probably worth \$30,000,000 when he died. He used part of his fortune to found Astor Library, which is now included in the New York Public Library. The present head of the family, Vincent Astor (1891-), owns much valuable real estate in New York. The story of John Jacob Astor's settlement in Oregon has been told by Washington Irving in his book entitled *Astoria*.

ASTROLOGY. One of man's oldest superstitions is the belief that the stars control his destiny. He has ever been fascinated by the mysteries of the heavens. And as a result a whole craft—almost a priesthood—developed around the theories of the stars' influence on humanity.

This craft, or pseudo-science, as it is called, is known as astrology. It consists largely of predicting the course of events by means of the heavenly bodies and their positions. Long ago astrologers worked

out a system of dividing the sky into sections called "houses." These were fixed arbitrarily and, of course, stars and planets moved through them in their orbits. According to the astrologers, each house represented some phase of life. One stood for riches, another for marriage, another for death, and so on.

When an astrologer set about forecasting the career of some individual, he first learned where the heavenly bodies were at the exact instant of his subject's birth. Then he took into account all the various influences at that moment. Each planet, each star, each moon meant something, and the astrologer put them all together in the form of a "horoscope." This supposed outline of a man's future included descriptions of his temperament, his health, and nearly every possible phase of his life.

With the coming of modern science, the influence of astrology and the power of its advocates has waned, though it is still pursued as a popular amusement. But in spite of its mythological character, it is considered the forerunner of present-day astronomy, just as alchemy preceded modern chemistry. At one time, no distinction was made between astrology and astronomy, but now the latter has become an extremely exact mathematical science, far removed from the witchery and "hocus-pocus" which for centuries surrounded astrology. See ASTRONOMY.



WONDERS of the HEAVENS

ASTRONOMY. More than all the other sciences, astronomy deserves to be called the "science of the universe." From the time when, as little children, we look out on starry nights and repeat the nursery rhyme, "Twinkle, Twinkle, Little Star," until we are grown old in years and experience, we never cease to marvel at the timeless march of the sun, moon, and stars across the sky, and the knowledge that our earth is just a tiny part of the universe.

Men have always been stargazers. They long ago began to study groupings of the stars, and speculate on the relation of our earth to them. After the telescope was invented, man began to make his knowledge exact, and increased it a hundredfold. Today, armed with knowledge, man can put man-made satellites into orbit that explore space and the earth for us, and help send messages around the earth. Man can also hit space bodies, and take pictures of them by means of space satellites. Radio telescopes reach out for noises from stars billions of miles away.

Astronomy a Practical Science. No other science is like astronomy in its appeal to the imagination, and yet astronomy

concerns in the most direct way our everyday lives and well-being. On one single star, the sun, we depend for our existence. The relations between earth and sun control life on this planet and give us our different seasons. Without astronomical figuring we should have no way of keeping exact time. Clocks gain and lose, but observations of the movements of the stars permit accurate corrections by a central regulator at the United States Naval Observatory.

Measurement of days, months, and years is based on astronomy. For practical purposes, a day is measured by the time it takes the earth to turn on its axis. A month is calculated from the time it takes the moon to circle the earth, and a year is determined by the length of time it takes the earth to circle the sun.

Again, surveys of large areas, such as states or continents, and the making of maps depend upon astronomy. Latitude and longitude are absolutely necessary in order to locate accurately the features on the maps. All sea-going craft depend upon astronomical observations to determine their position. If we remember that three-fourths of the earth's surface is covered

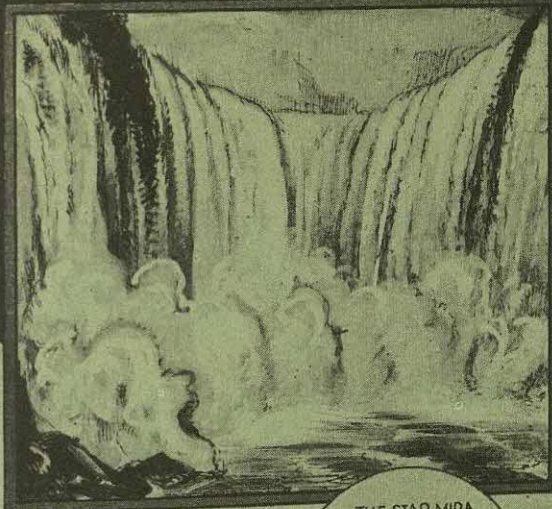
LIGHT-186,324
MILES PER
SECOND

SPIRAL NEBULAE
HAVE BEEN COM-
PUTED AT 12,500
MILES PER SECOND

SUN-200 MILES PER SECOND

EARTH—
18 MILES
PER SECOND

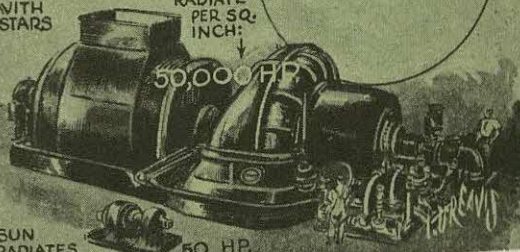
THE SUN'S LOSS IN
RADIATION PER
MINUTE IN TONS—
IS 480 TIMES THE
FALL OF WATER AT NIAGARA
—SAME SPACE OF TIME.



WITH ONLY 6 GRAINS
OF DUST IN ITS ENTIRE
INTERIOR, THE EMPIRE
STATE BUILDING
WOULD STILL BE
MORE CROWDED
THAN SPACE IS
WITH STARS

SOME
STARS
RADIATE—
PER SQ.
INCH:

THE STAR MIRA
COULD HOLD 30,
000,000 SUNS OR
39,000,000,000,
000 EARTHS



SUN
RADIATES
PER SQ. INCH:

50 HP.

Courtesy Popular Mechanics

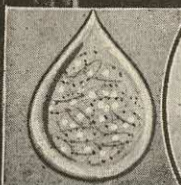
GREAT FIERY WORLDS BEYOND OUR TINY WORLD

Each of these pictures tells a wonderful story of thrilling happenings in the vast area around our world, which we call the Universe. There is blinding speed, limitless space and incredible power that man is studying and trying to understand.

A GIANT LARGE ENOUGH TO HOLD THE GREAT DIPPER WOULD BE ABOUT 398,867,328,000 MILES IN HEIGHT!

LIGHT WOULD BE NEARLY 7 YEARS PASSING FROM A TO B

A DROP OF WATER PROPORTIONATE TO THE SIZE OF THE GREAT DIPPER COULD ENCLOSE 25 SOLAR SYSTEMS



TO THE NEAREST FIXED STAR

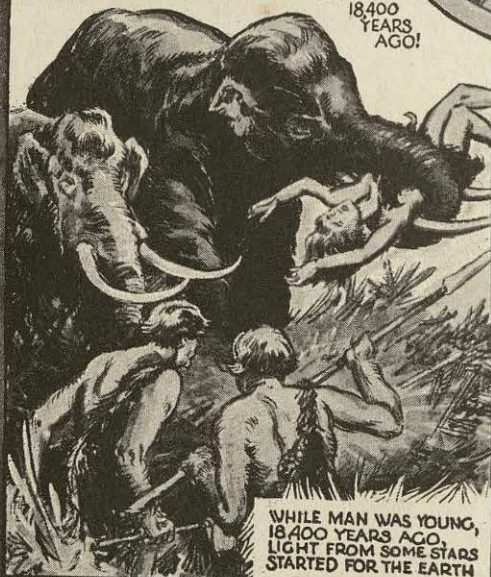
IT WOULD TAKE THE FASTEST PLANE 8 MILLIONS OF YEARS

A ROCKET MOVING AT 7 MILES A SECOND WOULD REQUIRE MORE THAN 16,665 YEARS

WITH EACH TICK REPRESENTING THE PASSAGE OF ONE YEAR, A CLOCK MUST STILL RUN FOR MORE THAN 4 YEARS BEFORE LIGHT FROM SOME DISTANT STARS COULD REACH US

KNOWN HISTORY PROBABLY LESS THAN 90 MINUTES

SOME STARS MAY SEE US AS OF 18,400 YEARS AGO!



AIRPLANE — 528 FEET PER SECOND

RACING CAR — 352 FEET PER SECOND

MOTORBOAT — OVER 161 FEET PER SECOND

BOAT ON SPEED

Courtesy Popular Mechanics

SPEEDING FASTER THAN ANYTHING ON EARTH

Distances are so vast in the Universe it would take the strongest light many thousand years to travel from the Earth to a distant star even though travelling at a speed of 186,324 miles a second.

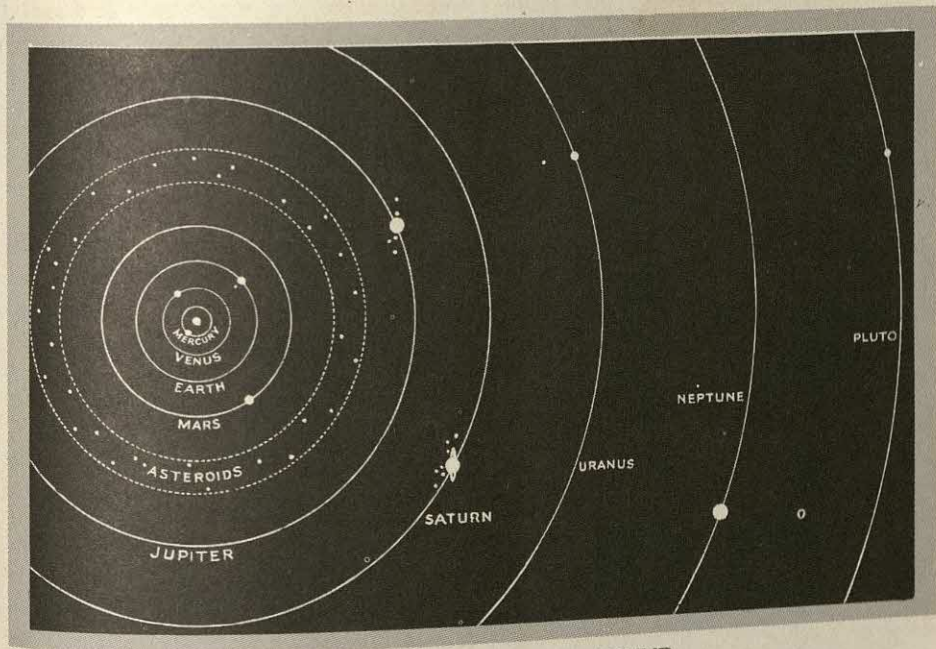
with water, we may realize how necessary it is to know where we are when we are traveling at sea.

Points of the compass—north, east, south, west—are determined by reference to the sun and stars, and many a lonely traveler has been guided at night by the star that points directly toward the North Pole—the North Star. Near this star is the familiar Big Dipper, a constellation we all can recognize. The stars at the front of the bowl are called the pointers, since a line drawn through them, from bottom to top, would be in the direction of the North Star. When that star is located, anyone puzzled about his directions can at once locate all the points of the compass, for the North Star is always north of him.

The Solar System. Our earth, which seems to us the biggest thing in the universe, is but a tiny planet in space so far-reaching no human mind can grasp it. It

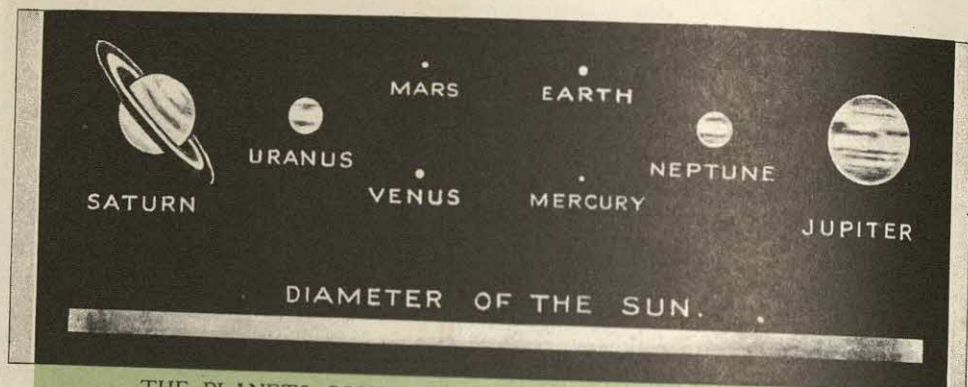
is one of nine planets grouped about the sun, which is the center of our solar system. These planets all revolve about the sun in orbits that are slightly oval-shaped, or elliptical. The sun itself is a star, though not a very large one when compared with some of the brightest ones that we see on the dome of heaven on a clear night. But it shines by its own light, while the planets, including even the largest ones, shine by the reflected light of the sun.

In order of distance, starting with the planet nearest the sun, the nine planets are Mercury, Venus, Earth (spelled with a capital when thus grouped with the other planets), Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto. In order of size, and beginning with the smallest, the planets are Mercury, Pluto, Mars, Venus, Earth, Uranus, Neptune, Saturn, and Jupiter. Between Mars and Jupiter there are a great number of midget planets called asteroids or planetoids.



A CELESTIAL MERRY-GO-ROUND

With the sun as a center, the nine planets and their satellites follow their eternal orbits in space, never swerving from their fixed paths. The planet nearest to the sun, Mercury, makes the circuit in eighty-eight days, one-fourth the time it takes Earth. The giant of all the planets, Jupiter, takes nearly twelve years for his circuit, while Pluto, farthest from the sun, takes 248 years.



THE PLANETS COMBINED WOULD BE LOST IN THE SUN

The diameter of the sun is nearly ten times that of Jupiter, the largest planet, and is 288 times that of Mercury, the smallest one. It would take 108 diameters the length of Earth's to make the sun's diameter of 864,000 miles.

An astronomer, Sir John Herschel, estimated that, if we represented the sun by a globe two feet in diameter, and figured the distance to the largest planet, Jupiter, it would be almost a quarter of a mile away. But far beyond Jupiter's orbit are the planets Saturn, Uranus, Neptune, and Pluto, the last discovered in 1930. Pluto is about eight times as far from the sun as Jupiter. These facts give us some idea of the extent of our solar system, but when we study the universe about us, we find that the solar system occupies but a very small area in the star world.

In this work are articles describing the planets under their names, and also an article **PLANET**. The reader will find there many interesting facts about the size of these bodies, their movements, and the satellites or moons that circle them about.

Comets. Among the most interesting groups of the heavenly bodies are those which are only occasional visitors to the solar system—the comets. They move about the sun in immense elongated orbits which reach far beyond Neptune. Each of them consists of a bright starlike point, or nucleus, surrounded by a less brilliant mass called the head, and with a large streamer, or tail, projecting many millions of miles into space.

Halley's comet, a small though recently observed one which returned to the solar

system in 1910, had a tail 37,000,000 miles in length when observed May 5. Its tail was so thin that the earth passed through it without any noticeable effect. It will return again about 1985. Comets are sometimes brighter than the sun and large enough to be seen with the naked eye in broad daylight.

Meteors, often called "shooting stars," are minute particles of matter revolving about the sun in elongated orbits. They are too small to be visible unless perchance they are drawn to the earth and the resistance of the air makes them glow. Most of them are entirely consumed before reaching the ground, but occasionally one falls to the earth, and is then called a meteorite. Usually it is a mass of stone, rarely pure iron or iron and nickel. Meteorites vary in weight from a few pounds to several tons.

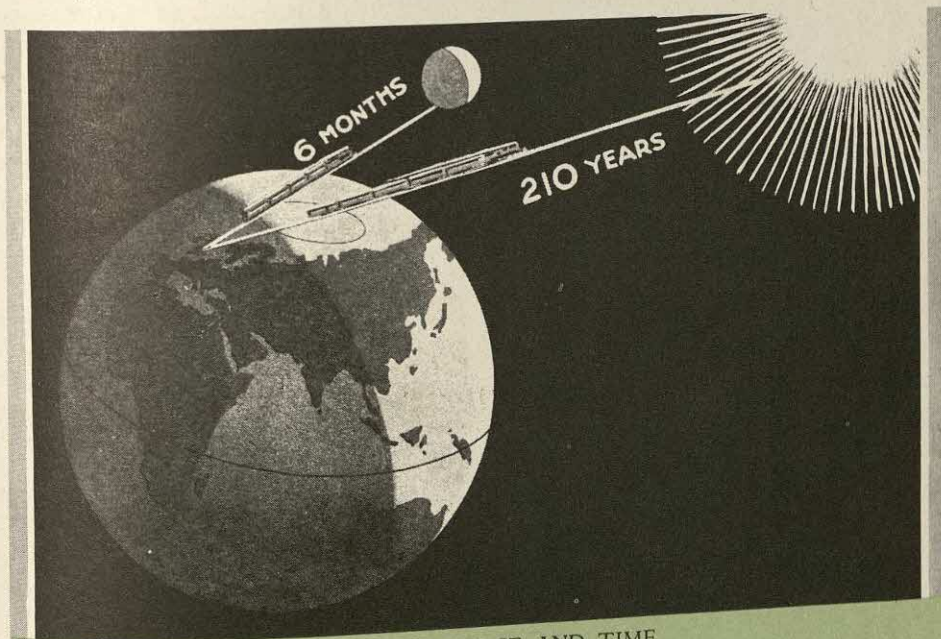
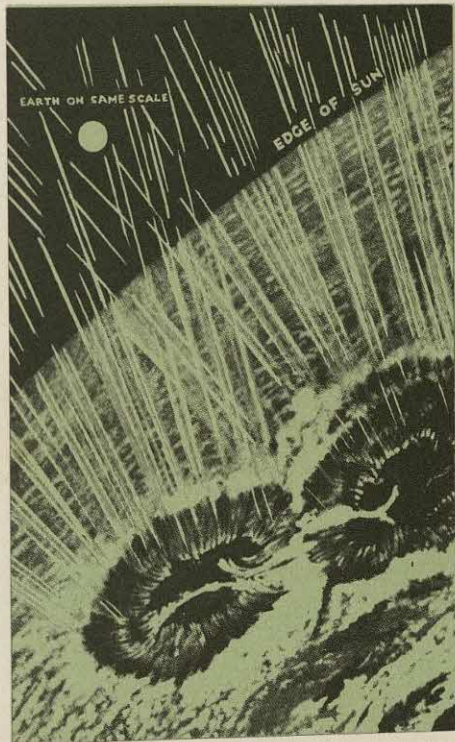
The Moon is the most interesting of the heavenly bodies for the observer who has only a small telescope. Because of its nearness its features can be most clearly discerned. It revolves about the earth, requiring for a complete circuit about twenty-seven days. It also rotates once in the same period, so that the same side is always turned toward us. As is the case with the planets, it shines by reflected light, and, of course, only the lighted portion is visible.

Because of its varying position relative

to the earth and sun during the month, we see varying proportions of the lighted half, from nothing at new moon to the maximum at full moon. The moon's surface is pitted with circular depressions resembling volcanic craters. It has neither atmosphere nor water.

Stars in Space. At certain periods of the year, we can see in the western sky, soon after sunset, a bright evening "star" that shines with a steady glow. As other stars come out and spread over the darkening sky, we can see, if we are observant, that they shine with a twinkling motion. These are the true stars, forming the group to which our sun belongs. The evening "star" that shines so steadily is really a planet — Venus, which sometimes also appears as a morning "star." Other planets, too, make dawn and dusk appearances.

True stars are composed of hot gaseous material and shine by their own light. On the other hand, the glow of the evening planet is the reflected light of the sun. The twinkling motion of the stars is an illusion



THROUGH SPACE AND TIME

Our Earth, so big to man, is but a speck in the universe. It is not even as large as a sun spot, shown above. Man could spend his entire life traveling on an express train toward the sun, and not be halfway there.



FLAMES OF GAS AMONG THE STARS

Comets that flash across the sky at intervals are mostly flaming gas, thinner than fog. The Pons-Winnecke comet of 1927 (right), as seen by the eye of the camera. One of the grandest objects of the heavens, the great nebula in the constellation Orion (left). It, too, is mostly gas.

due to the immense distances their light must travel before it reaches the eye. When astronomers look at planets through their powerful telescopes, these heavenly bodies show a disc, like that of the moon. But stars, far, far away in the measureless ocean of space, never appear as anything but points of light.

The stars differ from the planets in another respect. The ancients noticed that there were certain "stars" that appeared in different parts of the sky at different times, while the great host on the vault of heaven seemed to be fixed and unchanging. So they gave the former the name planet, which is from the Greek word for *wanderers*. We know why the planets appear as wanderers; their yearly revolution around the sun brings them into varying positions relative to our globe. But the stars in space are so far away we cannot detect any changes in their positions relative to each other. They are therefore called fixed stars.

They do change position, however, for

the stars are all of them traveling through space. They are separated from each other by such enormous distances that their changes of position remain unnoticed over long periods of time. But human eyes a million years from now will see a stellar arrangement quite different from the starry heavens that we of the twentieth century gaze upon.

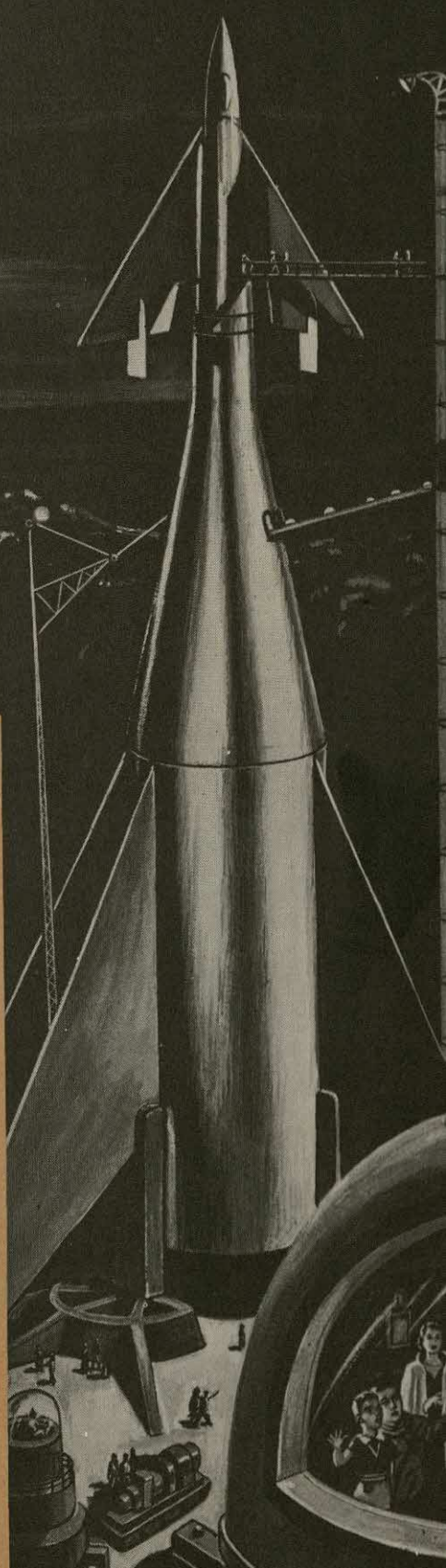
Distances in space are expressed by a convenient measure called the light year. This is the distance that light travels in one year, at the rate of 186,000 miles a second. The star nearest our solar system, Proxima Centauri, is about 4.3 light years away. That is, light from this star travels over four years before it reaches the earth. The sun is about 92,000,000 miles from us, and we get its light in eight minutes. What fraction of a light year is the sun's distance?

Stars vary in brightness, partly because of difference in size, and partly because those farthest away seem dimmer to us. Brightness of stars is expressed as magni-

A Wonderland Adventure in ASTRONAUTICS

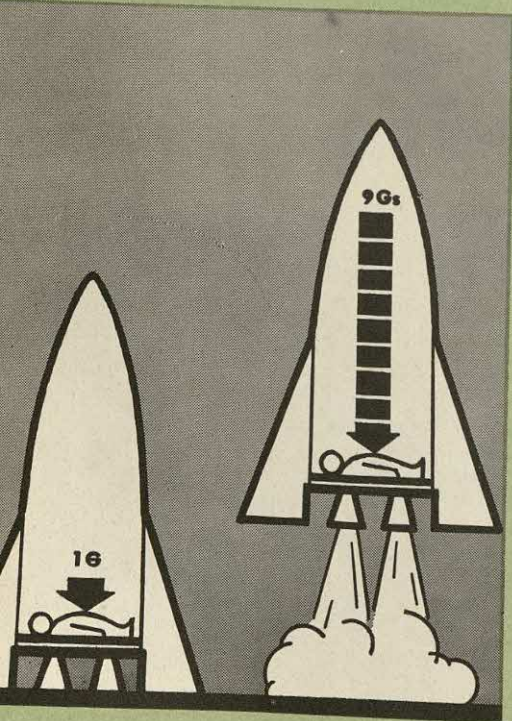
Drawings by Berthold Tiedemann

NEXT STOP—SPACE STATION. We take a last look at the night sky as seen from our home planet, Earth, before boarding the rocket ship by portable elevator. Behind us, an astronautical engineer works at the dials of the control station in preparation for the rocket's takeoff. Only the top part, or third stage, of the rocket will reach the space station. The lower two parts will drop off after expending the tremendous energy necessary to blast through the dense lower reaches of the atmosphere.

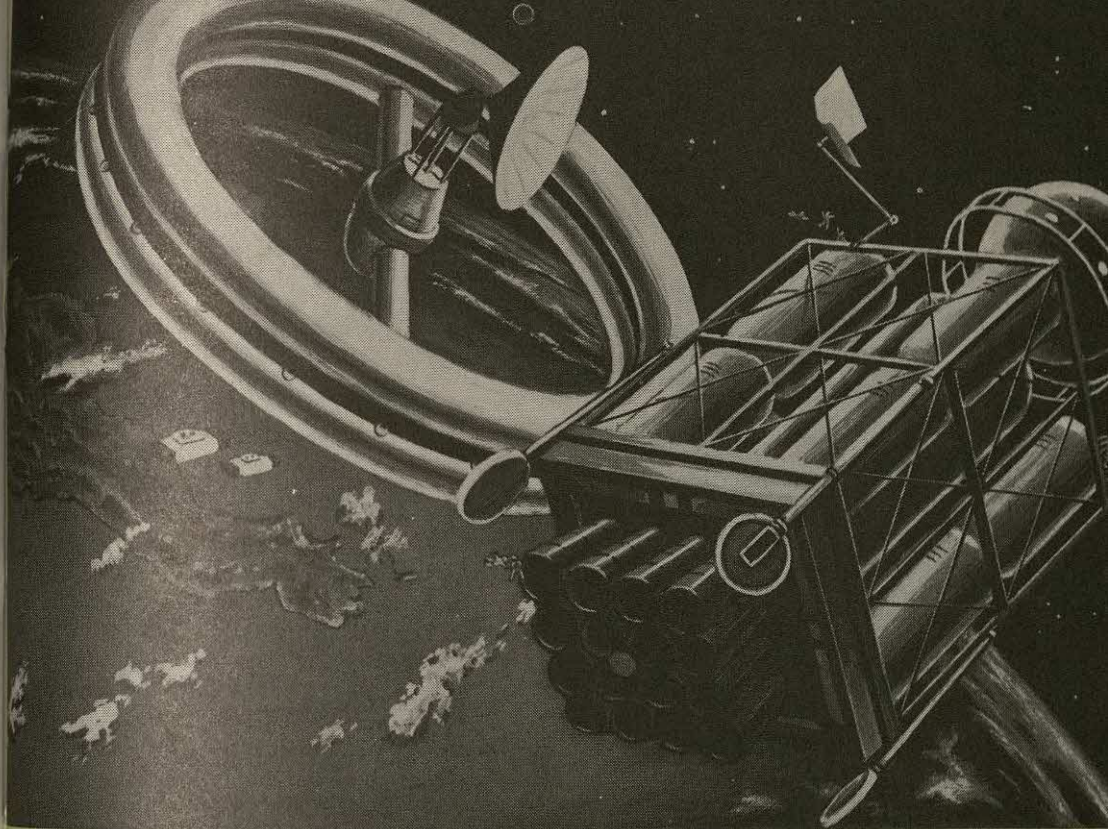


CHANGING "TRAINS" AT THE SPACE STATION.

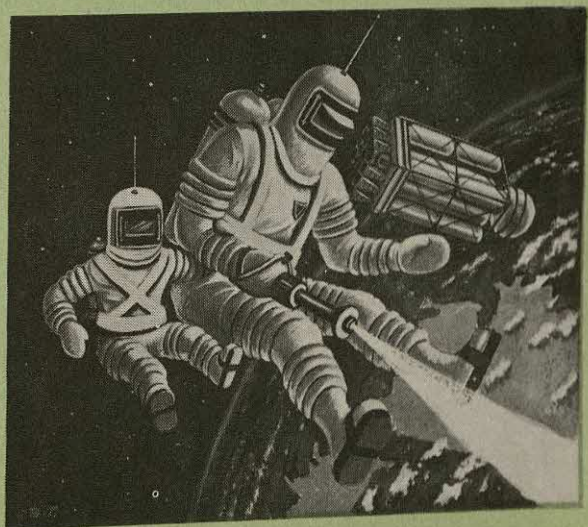
We leave our third-stage rocket, or earth ferry, and take a taxi over to the ring-shaped space station, where we may have a snack in the restaurant and send a postcard home. The loud-speaker-shaped device on the space station is part of a solar power-generating plant. The moon ship, at right, is not streamlined like the earth taxi because it does not have to combat the friction of the atmosphere. It is rocket-powered. We will ride in the sphere at its top. At the left of the sphere is a mirror to gather the sun's rays for the solar generator. At its right is the radar antenna. Fuel tanks make up the greatest part of the bulk of the ship.

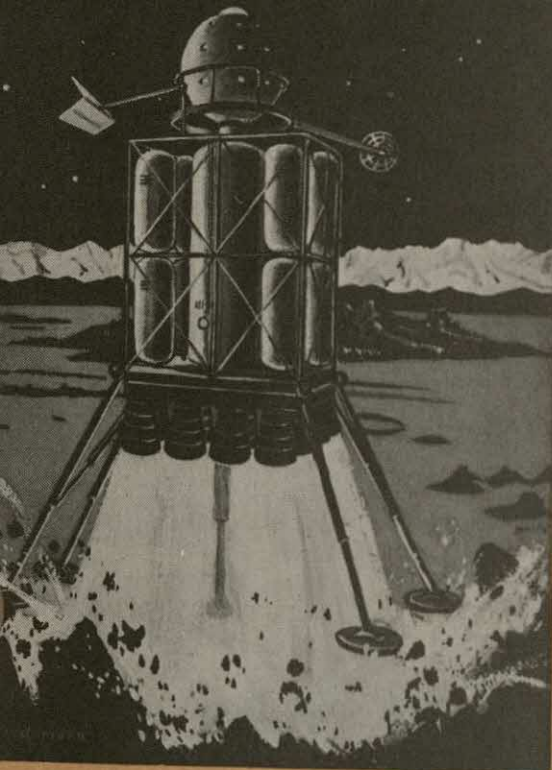


NINE TIMES THE FORCE OF GRAVITY may press down upon us as we take off from earth. This increase in Gs is caused by the acceleration needed to reach the upper atmosphere.



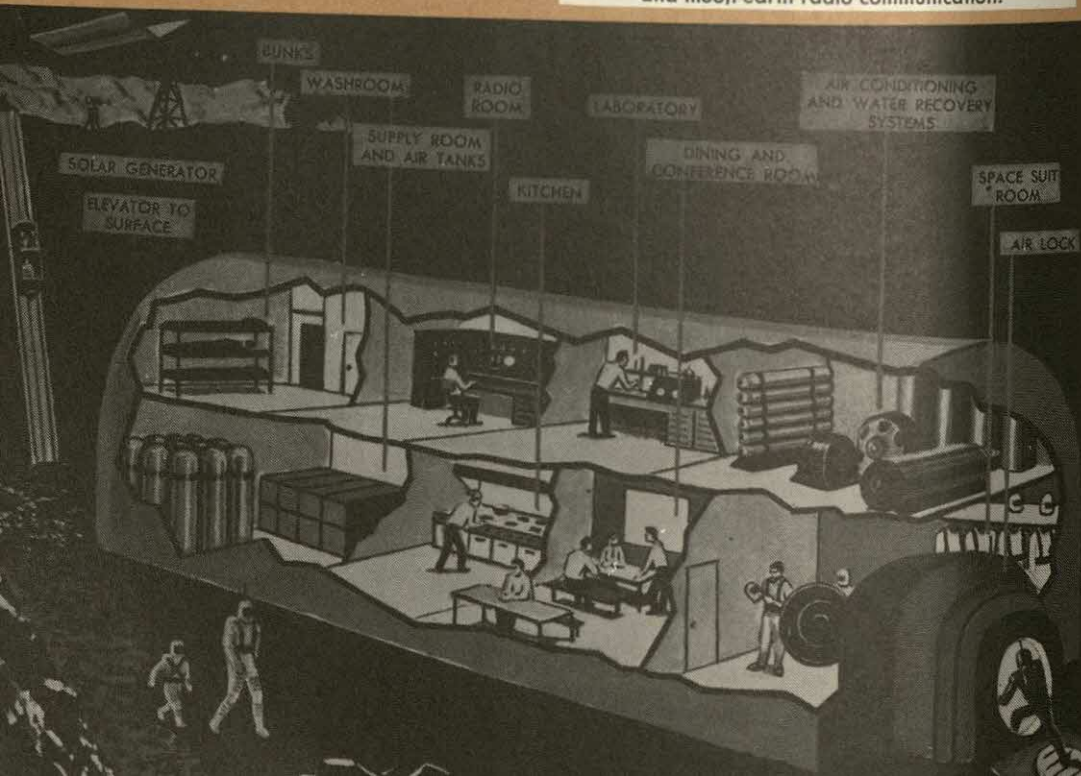
FLOATING IN SPACE, we try out our space suits before we transfer our luggage from the "earth ferry" to the moon ship, seen in the background. A weak blast from a rocket gun is enough to propel us about.





WE LAND ON THE MOON. The rocket ship lands backwards, so that the rate of descent can be controlled by the rocket motors. A retractable touch-down shoe, seen in the middle of the rocket blasts, absorbs much of the landing shock.

OUR EXPLORATION BASE ON THE MOON is located under a sheltering cliff. We must wear our space suits outside our moon home, because the moon has little or no atmosphere. We ride an elevator up to the rim of the small crater, where a solar generator has been set up to provide power for air conditioning, lights, heat, radar, and moon-earth radio communication.



tude. Earlier, those appearing brightest were said to be of the first magnitude, but we now say that they are of zero magnitude and that other very bright ones are of some percentage minus first magnitude. Then come those of first magnitude, on through those of the twenty-third magnitude, the faintest so far photographed. Groupings of stars, such as Orion, are called constellations.

The stars we see in the sky at night make up the great stellar universe of which we are a part. It is awe-inspiring to know that there are millions of other stellar universes like our own, but so incredibly far away most of them could not have been located without the aid of powerful telescopes. Spiral nebulae and island universes, astronomers call them. The nearest, in the constellation Andromeda, is a million light-years away. Sharp eyes can see this far-off world of stars as a bit of hazy light, without a telescope.

The fascinating story of astronomy is continued in many related topics. See, for example:

Asteroids	Milky Way
Aurora Borealis	Moon
Comet	Nebula
Constellations	Observatory
Copernicus	Satellite
Eclipse	Solar System
Fixed Stars	Spectroscope
Galileo	Star
Meteor	Telescope

ASTRO-PHOTOGRAPHY. The use of the photographic camera in the study of the heavens is known as astro-photography. This field was opened in 1840 when John W. Draper, an American chemist, took a picture of the formations on the moon's surface. Today, most astronomical research is carried on by photographing the heavenly bodies, for photographs are accurate and can be permanently kept for leisurely and comparative study. Many of the world's observatories now use the camera-telescope made known by Germany's Bernhard Schmidt in 1930. It not only takes sharply defined pictures of large areas at one exposure but it is also speedier

than its predecessors. The first of an improved version, produced by James Baker, of the United States, was installed in the Union of South Africa in 1950.

On October 7, 1959, the Russians took a picture of the side of the moon away from the earth. They sent the rocket Lunik III with two cameras 40,000 miles beyond the moon. There was forty minutes of picture taking. Radiophoto scanners transmitted the picture to earth. There was a twelve-hour long broadcast of the signals to earth, where they were reconverted into the picture.

ASWAN DAM. See ASSUAN DAM.

ATAHUALPA, *ah tah wahl' pah*. On the death of Huayna Capac, Inca of Peru, in 1525, his realm was divided between his two sons. Atahualpa received the kingdom of Quito, and Huascar ruled over the rest of the empire. In 1530 Atahualpa declared war upon his brother and completely defeated him. Huascar was thrown into prison and his empire was taken over by his brother (1532).

Then the Spaniards invaded their land. Pizarro, the Spanish leader, captured Atahualpa by a trick, and the Inca king offered a great ransom in gold for his freedom. When Huascar offered a greater sum to have his brother kept in prison, Atahualpa heard of it and had Huascar slain. The treacherous Pizarro accepted the gold of the Inca chief, but instead of setting him free, he accused Atahualpa of treason, put him to trial quickly, and executed him. See INCA; PIZARRO, FRANCISCO.

ATHENAEUM, *ath e ne' um*. The poets and other literary men of ancient Athens used to meet in the Athenaeum, temple of Athena, goddess of wisdom, to read and discuss their writings. Later there was a school founded by the Emperor Hadrian at Rome for scientific and literary studies, and it, too, was called the Athenaeum, and had a regular faculty of teachers. The name has also been given to schools at Lyons, Marseilles, and other cities, and to literary clubs in America.

ATHE'NA. See MINERVA.



HEIR TO GREATNESS

The tradition of learning befits Athens, where the city's university is close to classic ruins.

ATHENS, *ath' enz*. Important today as the capital of Greece, Athens was in ancient days one of the greatest cities in the world. There, art, literature, and philosophy flourished to an extent unsurpassed in any other city in history. Athens was the center of Greek civilization and represented all that was best in culture. It gave the world its first taste of democracy and showed how much progress man can make through peaceful pursuits. It represented a high type of loyalty, for to Athenians their city came before anything else.

Today, all that Athens has to show for its ancient glory are the ruins of beautiful buildings and splendid statues. But its contributions to civilization remain in the schoolbooks, libraries, universities, laboratories, art galleries, and theaters of the modern world.

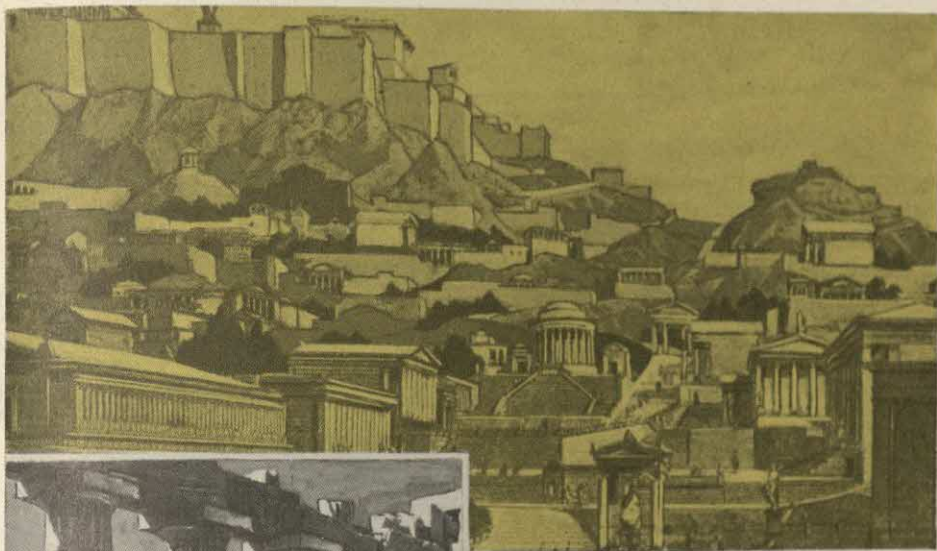
Modern Athens. As in ancient times, the city still clusters about the Acropolis, a hill almost 300 feet high. Modern Athens has broad streets and handsome build-

ings. A number of boulevards extend from the Square of Harmony. Some of the important modern buildings are the House of Parliament, the National University, and the marble Stadium. One of the important educational institutions is the American School of Classical Studies, supported by universities in the United States. Athens is today the banking and business center of Greece. The chief manufactured products are rugs, silks, scarfs, and metal goods. The population is about 560,000. Nearby Piraeus is its port.

The Period of Glory. Like many other cities, the origin of Athens is based on a legend. The story is that Athena and Neptune held a contest to decide which should name the city. Athena won, and the city became Athens. Throughout the history of ancient Greece, the goddess was the patroness of the great city. The first king of Athens is said to have been Cecrops. Following him came the hero Theseus, who is credited with uniting the independent townships of Attica. The last king of Athens was Codrus. Then for a long period the aristocrats had control of the city and ruled by tyrannical methods. Finally, the people revolted and set up new laws, drawn up by Solon.

In 509 B. C. a new constitution was adopted, setting up a democratic form of government. About ten years later the Persian Wars began, at the end of which, Athens emerged as the leader of Greece. The Confederacy of Delos was organized about 476 B. C. with Athens at the head. In 449 B. C. Pericles became the ruler of Athens. It was during the period of his rule that the city reached the height of its power, when the greatest temples and other works of art were erected.

The Propylaea, or Gateway, was built at the west end of the Acropolis. It was constructed of white marble and trimmed with black marble. Sixty marble steps led to the colonnades and porticoes of the structure. On top of the Acropolis, just beyond the Propylaea, was a huge statue of Athena. Farther back and to the right



THE GLORY THAT WAS ATHENS

The ancient Grecian metropolis at the height of her glory was the site of magnificent marble buildings of surpassing classic beauty. Today, though in ruins, such fragments of the Parthenon (left) as remain to us, still express the spirit of a superb culture.

grew jealous of Athens and demanded that she free all the other cities. Wars resulted, and Athens lost much of her power and began to decline. But she kept her cultural position. When the Romans came to power, Athens was still the seat of learning; but when Rome fell, the history of the famous city became a blank until the eleventh century.

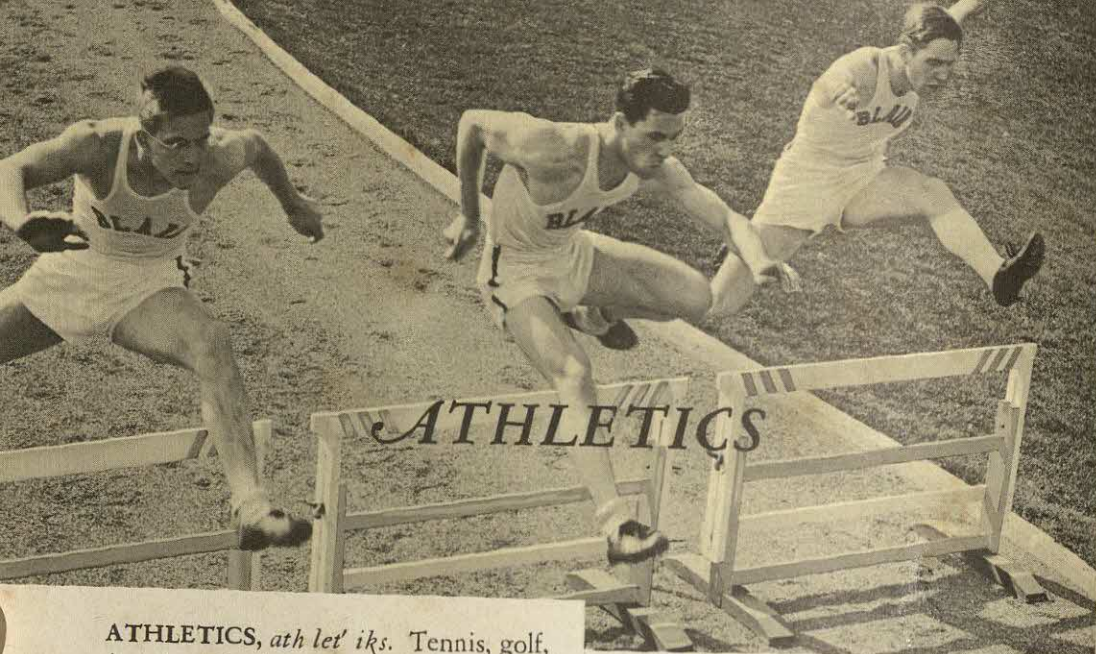
In the next three centuries the city was ruled by Turks and Italians at various times and sometimes was independent. Athens was under Turkish rule in the eighteenth century. But in the nineteenth century (1821-1833) the Greeks revolted and set up their own kingdom, with Athens as the capital.

In 1896 the ancient Stadium was restored, and the Olympic Games were revived in Athens. The games served to reawaken interest in Athens, and many tourists and scholars have since gone there to visit and study the ruins of the ancient city. See OLYMPIC GAMES; GREECE; PERICLES.

was the Temple of Wingless Victory (Nike Apteros). The open space on the Acropolis was flanked on the right by the Parthenon, an architectural triumph of all time; on the left stood the Erechtheum, which contained the famous Porch of the Maidens.

Athens, at the height of her glory, had other beautiful buildings. To the north-west lay the Theseum, a beautiful temple which is still well preserved. On the south slope of the Acropolis was the Theater of Dionysus; there, too, was the Olympieum, which took 700 years to complete.

The Period of Decline. Toward the end of the reign of Pericles, the Peloponnesians, under the leadership of Sparta,



ATHLETICS, *ath let' iks*. Tennis, golf, swimming, boxing, running, jumping, wrestling—these and numerous other athletic sports and games are known and practiced in many countries. Taking part in athletics are all sorts of people, from Olympic champions to small boys playing baseball in a sand lot.

Loosely Organized Sports. Athletics are natural activities for human beings. Running, jumping, and throwing form the basis of all sports. A baby naturally knows how to pull, push, grasp, and kick. As he grows older, he develops these natural actions further and creeps, walks, and throws; then, shortly, he begins to jump and run. In time he plays tag, hide-and-seek, and ducks and drakes and engages in games like tug-of-war and push ball. These are loosely organized athletics, so-called because they require no formal training. Yet they help to build the body and provide healthful and valuable exercise.

Highly Organized Athletics. It is in the games requiring training and skill, however, that character is built. In group games, such as football, basket ball, and baseball, one learns to co-operate with his teammates and develops a sense of leadership, friendliness, obedience, self-sacrifice, loyalty, fair play, sportsmanship, and re-

spect for others. In individual sports, such as swimming, track, and boxing, he learns self-confidence, courage, resourcefulness, quick thinking, initiative, and self-control. People have come to realize that all these qualities gained through participation in athletics make better citizens and thus better and greater nations.

The ancient Greeks well realized this fact. All youths were taught to develop their bodies as well as their minds. Great athletes were considered heroes. The Greeks encouraged track and field sports, climaxed by the famed Olympic Games. But the Greeks were not the first to take part in sports. Long before the days of Greek athletic contests, the Egyptians and some Asiatic peoples practiced various games.

In the United States the Amateur Athletic Union is the leading organization of amateur athletes, holding annual contests in track and field, swimming, boxing, basket ball, and other sports. The Intercollegiate Association of Amateur Athletes of America and the National Collegiate Athletic Association promote competitions among universities and colleges. In addition, many high schools and colleges belong to local conferences which determine athletic championships in football.



THE OLDEST OF SPORTS
Track events have thrilled the spectators since the days of the ancient Egyptians. Above, "putting the shot." Center, a champion broad jumper in action. Right, a distance runner breaks the tape to win.

tennis, golf, baseball, swimming, track-and-field events, basketball, and numerous other sports.

Often international contests are held in tennis, golf, polo, rowing, swimming, and track-and-field sports. The modern Olympic Games, held every four years, are the most important international contests.

Amateurs and Professionals. Athletes are classified as amateurs or professionals. In general, an amateur athlete plays for the pleasure and physical benefit to be gained from a sport. Once he accepts pay for his skill, he is in the professional class with those athletes who compete for money. All college athletics are amateur. Football, the leading college sport, attracts the largest crowds. Baseball, the American national sport, is highly organized professionally but is, of course, widely played by amateurs, too. Lacrosse is a national sport of Canada; cricket is the most popular game in England.

Track and Field. Of the major forms of athletics, track-and-field events are prob-

ably the most ancient. These contests that take place on the track, such as the dashes, distance runs, and hurdle events, are known as track events. The field events include the high jump, broad jump, pole vault, shot-put, hammer throw, discus throw, javelin throw, and hop, skip, and jump.

Hurdle races are held over two distances in most outdoor track meets, 120 yards and 220 yards. In the shorter race, called the "high hurdles," there are ten hurdles, each three feet, six inches high. In the longer race, or "low hurdles," there are ten hurdles, each two feet, six inches high.

The **pole vault** is an event requiring strength and timing. The vaulter uses a bamboo pole about sixteen feet long, runs with it down a runway, and attempts to throw himself over a bar supported by two standards, using the pole as a lever. Champion vaulters have reached heights of more than fifteen feet.

In the **shot-put** the object is to throw a sixteen-pound ball as far as possible. High-school athletes use a twelve-pound ball. The shot-putter stands in a circle, beyond

which he must not step during his throw. Records for shot-putting exceed sixty-four feet.

In the *hammer*, *discus*, and *javelin throwing* events, the object is the same as that in the shot-put, to throw as far as possible. The hammer is a sixteen-pound ball to which a chain is attached. A handle is at the other end of the chain, not more than four feet from the ball. The hammer thrower stands within a circle, whirling the missile around his head with increasing speed. He must let go the hammer without stepping outside the circle. The discus is a flat, circular object like a disc wheel. It is eight inches in diameter and two inches thick in the middle; it weighs four and one-half pounds. It, too, is thrown from within a circle. A javelin is a spear about eight and a half feet long, with a tapering steel point. It is thrown from a line after a brief run.

Training. To throw a javelin more than 250 feet, to punt a football sixty-five yards, or to score ten field goals in a basketball game requires a great deal of practice and teaching. Coaches are hired by schools and colleges to instruct and guide athletes so that they may win contests for their schools. These coaches devise new plays for the football and basketball teams, drill track men and swimmers so that they can achieve the greatest amount of speed, and see that athletes are kept in the proper condition. An athlete must get plenty of sleep and the right kind of food, he must have the proper clothing and equipment for various sports, and he must always be prepared to exert himself if he wants to be an individual champion or a member of a winning team. Continuous practice and right living enable him to do so.

Women's Athletics. Although women do not have the endurance or strength of men, they have become quite proficient in many sports, attaining great speed and skill in tennis, swimming, golf, field hockey, archery, bowling, and track and field. Their group games are as exciting

and spirited as are men's. Every year more women's baseball, basket-ball, and volley-ball teams are being formed.

For further study of athletic sports and games, the following articles may be consulted:

Archery	Olympic Games
Baseball	Physical Education
Basket Ball	Ping Pong
Bowling	Polo
Boxing	Race
Canoe	Rowing
Cricket	Shot, Putting the
Discus, Throwing the	Skates and Skating
Falconry	Ski
Fencing	Swimming
Football	Tennis
Golf	Tobogganing
Gymnastics	Water Polo
Hockey	Wrestling
Lacrosse	Yacht and Yachting

ATH'OS, MOUNT. At the foot of Mount Athos, in Greece, the invading Persian fleet of Mardonius was wrecked in 492 B. C. When the famed Persian conqueror, Xerxes, organized the greatest army of those ancient days to subdue Greece, he planned a way to avoid another shipwreck there. His engineers dug a canal across the narrow strip of land that links the mainland of Greece to the peninsula of Athos, easternmost of the three peninsulas that jut out into the Aegean Sea. The traveler today can still see traces of that canal.

Mount Athos rises 6,350 feet from the sea at the end of the peninsula. It is said that no women are allowed upon it. Modern Greeks call it the Holy Mountain, for in its neighborhood are about twenty monasteries and the homes of many hermit monks; religious pilgrims visit the mountain, and the people there earn a living by selling religious images, rosaries, crucifixes, and other emblems. The region of Athos was a center of learning and of religious study in ancient times, and in its monastery libraries today are valuable manuscripts and literary works.

ATLAN'TA, GA. Out of the ashes of the city burned by Sherman's men rose the new city of Atlanta, to become capital

of Georgia, capital of the cotton country, bustling business center of the Southeast.

"Atlanta to the sea," familiar phrase of the old song, calls up to memory the tragic plight of the city at the close of the war between the states. Atlanta was young then. The first house was built on its site in 1836. The town was incorporated as Marthasville in 1843, and was renamed Atlanta two years later.

It became an important military post during the war; then, triumph for the Union forces and tragedy for the Confederates, General Sherman's Union army captured the city in 1864, and when the soldiers moved on to begin Sherman's famous march to the sea, Atlanta was nearly wiped out by fire. But it was quickly rebuilt after the war, became the state capital in 1878, and from a population of 11,000 at the start of the War between the States, has grown into a city of over 331,000 people. Greater Atlanta, taking in the surrounding suburbs, has a population of about 672,000.

Popularly called the "Gate City of the South," Atlanta is a well-located commercial center. Situated northwest of the center of Georgia, near the southern end of the Appalachian Mountains, in Fulton and De Kalb counties, it is a major railroad, airline, bus-route, and highway hub. Nearly all the goods shipped between the Gulf States and the North pass through the city. Although Atlanta is not on a navigable stream, the nearby Chattahoochee River generates electricity for its use.

The Federal Reserve Bank of the Sixth District is in Atlanta, as are numerous offices supervising Federal government work in the Southeast. Also there are the million-dollar State Capitol, built in 1889 and modeled on London's St. Paul Cathedral, and the circular "Cyclorama of the Battle of Atlanta." One of the world's largest paintings, fifty feet high, 400 feet around, and weighing nine tons, the "Cyclorama" is a famous tourist attraction. The blooming of Atlanta's dogwood trees is celebrated in a yearly spring festival.

Surrounded by cotton plantations, Atlanta naturally grew into a manufacturing city where cotton goods, cottonseed oil, and similar products are made. The city also has flour mills and furniture, shoe, fertilizer, and steel factories; perhaps its most famous product is the soft drink Coca-Cola, which originated there.

Among the institutions of higher learning in Atlanta or its suburbs are the Georgia School of Technology and Oglethorpe and Emory universities. Negro institutions of the Atlanta University System, founded in 1865, include Atlanta University and Clark, Morehouse, and Spelman colleges.

ATLAN'TIC OCEAN. The busiest highway in the world was once the barrier that for unnumbered centuries hid America from Europe. Viking oarsmen and Mediterranean sailors dared not venture too far out into the unknown Atlantic Ocean, for to them it marked the end of the world. Somewhere, they thought, there was a slipping-off place where foolhardy mariners would tumble off the edge of the earth.

Some say Norsemen sailed out across the North Atlantic and discovered America long before Columbus. But certainly the bold voyage of Christopher Columbus in 1492 marks the beginning of transatlantic travel and commerce. Today the Atlantic lanes are crowded with freight and passenger ships, from tiny sailboats of fishermen and sportsmen to the few big four-masters still plying the seas, with their cargoes of grain and lumber; from slow-going little motorships to swift, giant liners that, in less than three and one-half days, make a crossing that took Columbus over a month. Huge airplanes now fly from Europe and Africa to North and South America. And the human voice and written messages leap across or beneath the Atlantic by radio and underseas cable.

Size of the Atlantic. More important commercially than the Pacific Ocean, the Atlantic is half as large. The main basin covers over 31,800,000 square miles. If the

Arctic and Antarctic circles are considered its northern and southern boundaries, it is about 9,000 miles long. If the Antarctic is not considered a separate ocean, the Atlantic's length is some 13,000 miles. Its greatest width, between Florida and Gibraltar, is about 4,150 miles; its narrowest, between Greenland and Norway, about 700 miles. The "waistline" between the South American and African bulges divides it into the North Atlantic and the South Atlantic.

Currents. This saltiest ocean has several strong currents flowing through it. The Gulf Stream, carrying warm tropic waters northward, then eastward, makes northwestern Europe warmer than northeastern North America, although both are in the same latitude. The Labrador Current, moving southward from the Arctic Ocean, chills eastern Canada and New England and often brings hazardous fogs and icebergs down into the Atlantic's traffic lanes. South Atlantic currents, weaker than those farther north, include the warm Brazil and the cold Falkland. The Benguela, off the southwestern African coast, also is cold and often brings fog.

Temperature. Water at the ocean's bottom is near freezing. At the top it varies from about 80°F. in the tropics to some 28° in the icebound polar regions. Thus in the extreme north and south, the water at the bottom is warmer than that on the surface.

Floor. If you could drain the Atlantic dry, you would find that its floor is made up of deep valleys and canyons and lofty ridges, plateaus, and even mountains. An S-shaped ridge, running north and south for some 8,000 miles, divides the Atlantic's bed into two valleys, each about 500 miles wide. The eastern valley averages about 14,000 to 15,000 feet in depth; the western one, from some 13,000 to 16,800. North of the Azores the bottom gradually rises to form Telegraph Plateau, so called because the Atlantic Cable is laid on it. It extends from Newfoundland, off Canada, to the Hebrides Islands, off Scotland.

The Atlantic's greatest known depth, discovered in 1939, is north of Puerto Rico. Since it is 30,246 feet below the surface, Mount Everest, the world's highest peak, would be covered with water if it rose from this spot. East of Newfoundland, depths of 20,000 feet have been found, and the South Atlantic has areas from 20,000 to some 26,500 feet deep.

In 1952 American scientists discovered a 300-foot-deep canyon at least 800 miles long in the Atlantic's floor. Lying some 800 miles northeast of Boston and extending southward, it is believed to be the main stream of a gigantic river system.

Islands. The Atlantic's islands are deposits of coral shell, volcanic peaks, or mountain ridges rising above the surface. Important North Atlantic islands include the British Isles, Greenland, Iceland, Newfoundland, and the Faroes, Azores, and Canaries. South Atlantic islands, less important, include the Falklands.

Products. The Atlantic is a source of fine food fish. Its important fishing grounds include the Grand Banks, off Newfoundland, and the Dogger Banks, in the North Sea. From its inlets also come oysters, lobsters, and other shellfish. Sponges, pearls, and many plants useful as medicines, chemicals, or fertilizers are other important products. Magnesium salts are now recovered from sea water, a cubic mile of which contains over 5,000,000 tons of this essential element. Both coal and oil also are taken from the Atlantic's underwater storehouses. See OCEAN; SARGASSO SEA.

ATLAS. As a punishment for rebelling against him, the Greek god Zeus condemned this giant Titan to carry the heavens on his shoulders. But Atlas, wearied from centuries of burden-bearing, asked Perseus, who was passing by, to let him see the head of Medusa, which turned to stone anyone who saw it. Perseus agreed, and Atlas was changed into the African mountains which bear his name. Because the earliest books of world maps showed a picture of Atlas shouldering the world, such books are called atlases.

ATLAS MOUNTAINS. Extending from northeast to southwest across parts of Morocco, Algiers, and Tunis, in North Africa, the Atlas Mountains are about 1,500 miles long. They were named for the Greek Titan Atlas and gave their name to the Atlantic Ocean (see *ATLAS*). The system is composed of several parallel ranges, separated by high plateaus. The low *Maritime Atlas* chain skirts the Mediterranean shore. Southward is the *Grand Atlas*, which has the loftiest peaks, including Toubkal (about 13,665 feet), in Morocco; then the *Middle Atlas*; and finally the *Saharan Atlas*, which extends into the Sahara. Because they rob the winds from the Mediterranean of their moisture, these mountains are responsible for North Africa's dry areas; they make the Sahara a desert. Valuable forests cover the northern slopes, but hot, dry winds from the desert make the southern slopes barren and sandy. The ranges contain iron ore, silver, fine marble, and other minerals.

ATMOSPHERE, at' mos feer. The colorless, tasteless, odorless air surrounding the earth, which is called atmosphere, is essential to all plant and animal life. Without the oxygen it supplies for breathing, no animal life could exist. Although man can go without food or water for days, he can live only a few minutes without air. Both plants and animals must also have the air's water vapor. Because the atmosphere absorbs the sun's heat, it serves as a protective blanket for the earth, keeping it from becoming unbearably hot in daytime. Without the heat thus absorbed, the nights would be bitterly cold. Fire, so important to man, would be impossible without air. Air also carries the sound waves that enable us to have radio and television; supports birds, other flying creatures, and aircraft; pushes sailboats and windmills; and serves countless other purposes.

The height to which the atmosphere extends is unknown, but we are certain that it exists over a hundred miles above the earth's surface. The atmosphere closest

to the earth is called the *troposphere*; that higher up, the *stratosphere*. See *STRATOSPHERE*; *TROPOSPHERE*.

Air is a mixture of various gases, about 78 per cent of it being nitrogen, 21 per cent oxygen, and 0.94 per cent argon. The rest consists of small quantities of carbon dioxide, hydrogen, ozone, neon, helium, krypton, xenon, and other gases. Water vapor is evaporated into the air from oceans and other bodies of water, from the water that falls as rain or snow, and from the moisture given off by living plants. Air also contains dust, microbes, pollen grains, plant spores, salt from the sea, and other small particles of solid matter.

We cannot see air, but it has weight. In the 1600's the Italian scientist Torricelli found that the air over a surface one inch square weighs exactly as much as a column of mercury about thirty inches tall (see *BAROMETER*). Later scientists have estimated that the air surrounding the earth weighs millions of billions of tons.

Air also exerts pressure—14.7 pounds to the square inch at sea level, but varying from hour to hour and decreasing with an increase in altitude. On high mountains it is so rare and thin that breathing is difficult, and above six miles it is too thin to support human life. Thus aviators, balloonists, and mountain climbers going to great heights must carry along a supply of oxygen. The air's pressure on the average human body is no less than fourteen tons, but it is exerted equally in all directions, and the body's gases exert an equal push in the opposite directions. Thus the pressure is felt little, if at all, by the individual.

Air is buoyant and can be expanded and compressed. Because it has these properties, vacuum cleaners, pumps, and pneumatic tools work, air brakes stop trains and trucks, aircraft fly, and many other machines and devices operate. Compressed air is used to inflate tires, spray paint, blow light bulbs, fill diving suits, hold back mud during tunnel building, and drive water from the ballast tanks of submarines.

ATOM, *at' um*. This is the very smallest particle into which an element can be divided by ordinary chemical means. Elements are the basic substances that make up our physical universe. Each element has its special kind of atom. For example, the atoms of the element copper are all alike chemically, and they are all different from the atoms in any other element. All matter, whether it be solid, gaseous, or liquid in form, is made up of atoms. Two or more atoms may be united to form a molecule. When two atoms of the element hydrogen are united with one atom of the element oxygen, a molecule of water is formed. The water molecule can be separated into hydrogen and oxygen; atoms cannot be subdivided by ordinary chemical methods (see **MOLECULE**).

Bacteria, those tiny organisms of the plant world, may be seen through a microscope, but atoms are so small there is no device that can make them visible. About 100 million atoms of an average size, placed side by side, would form a row only one inch long. Although scientists cannot actually see atoms, through research and experiment they have learned a great deal about the structure of atoms and how they work. In 1803 John Dalton, English scientist, published a theory that was accepted for nearly a century; he believed that the atom was solid, absolutely indivisible, always intact. Another English scientist, J. J. Thomson, announced in 1897 that atoms contain smaller particles. Twentieth-century scientists discovered that atoms can be broken up by special processes (see **ATOMIC ENERGY**).

The most important atomic particles for the student to know about are the *electron*, the *proton*, and the *neutron*. Electrons and protons are electrically charged particles; neutrons are neutral particles, having no electrical charge. Electrons are negatively charged; protons are positively charged. Protons and neutrons are found only in a central core, or *nucleus*, of the atom. Electrons are outside the nucleus. One may get a simplified picture of the

atom by thinking of it as a tiny "solar system" with the central nucleus as the "sun" and the electrons as a "planetary system" revolving in paths around the center. Small as the atom is, its diameter is 10,000 times the diameter of the nucleus, and the revolving electrons are so far from the tiny center that the atom itself is mainly empty space.

Practically all the weight and mass of an atom is in the nucleus. The proton is about 1,837 times heavier than the electron, which is the lightest negatively charged particle known. The neutron has almost the same weight and mass as the proton, but is slightly heavier. We have the picture, then, of a heavy, positively charged nucleus and almost weightless, negatively charged electrons revolving about it at high speed. The number of protons in an atom is always the same as the number of planetary electrons, and the positive electrical charge of each proton is equal in amount to the negative charge of an electron. Therefore, under ordinary conditions, the positive and negative charges balance each other, and the atom is neutral.

At least one hundred elements have been discovered. A table of elements arranged in order according to number of protons and electrons shows that each successive element has one more proton in the nucleus than the one before it. Hydrogen, the lightest element, has but one proton. It is the only element having no neutron in the nucleus. Since the number of protons determines the *atomic number* of an element, hydrogen has the atomic number 1. Helium, with two protons, is the next in order, and so on. (See table in the article **CHEMISTRY**.) Atomic number is the clue to the chemical properties of elements; the number of protons governs the number of electrons, and electrons determine chemical changes.

Atomic weight, on the other hand, represents approximately the sum of the protons and neutrons in the nucleus. But the precise sum is called the *mass number*. It is equal to the nearest whole number

of the atomic weight. Scientists do not use a measure such as the gram in expressing atomic weight, for to do so they would have to use long, cumbersome numbers. A decimal fraction consisting of 23 zeros and 3 digits would be needed to express in grams the weight of just one atom of hydrogen. Instead, the oxygen atom, which has 8 protons and 8 neutrons in its nucleus, is given an atomic weight of 16, and this is used as a standard. Hydrogen is slightly more than one sixteenth as heavy as oxygen, and its atomic weight is given as 1.008. Sulphur, with an atom about twice as heavy as the oxygen atom, has an atomic weight of 32.06. In the atoms of any element the number of protons is fixed. But the atoms of many elements have a varying number of neutrons. The chemical properties of these atoms remain the same; their weights vary slightly because the mass of the nucleus in each case varies. Such atoms or elements are called *isotopes*.

ATOMIC ENERGY is the form of energy that is locked in the nucleus of an atom and holds its parts together (see *ATOM*). Energy is defined as that property of a body which enables it to do work. Under ordinary conditions the energy of an atomic nucleus is stored, or potential, energy. After years of research and experiment, scientists learned how to release the energy locked in the nucleus and to change it from potential to kinetic energy (energy in motion). The explosion of the first atomic bomb in 1945 revealed to the world the power of the weapon man had devised through breaking up the nucleus of the atom (*nuclear fission*).

Both mass (matter) and energy are involved in nuclear fission. A basic principle of the older physics was that matter and energy could be neither created nor destroyed, but scientists later modified this theory of conservation. Atoms are destroyed and matter is converted into energy in the breakup of the nucleus. Actually it is the *total amount* of matter and energy in the universe that remains unchanged. In 1905, in his special theory

of relativity, Einstein set forth the relationship between matter and energy. He stated that matter (or mass) and energy are the same, one being a form of the other, and that under certain conditions each could be changed into the other. He pointed out that a small amount of matter could produce great quantities of energy and expressed this idea in the formula $E=mc^2$. In other words, energy (E) equals mass (m) times the square of the speed of light (c^2).

In this formula energy is expressed in ergs, mass in grams, and the speed of light (186,280 miles per second) in centimeters per second. Since c^2 equals 900 billion billion centimeters, it follows that the energy liberated by a small amount of mass is tremendous. It has been computed that the complete change of one gram of mass into energy can supply enough energy to drive a battleship around the world.

The French scientist Henri Becquerel found the clue to nuclear fission in 1896, when he discovered that a type of uranium ore called pitchblende powerfully affected a photographic plate when placed near it. Pierre and Marie Curie continued the research and recovered from the ore a material that proved to be a form of a new element they called radium. The remarkable properties of this element were investigated by Sir Ernest Rutherford and other scientists. They found that radium was giving off three types of rays and, over a long period, changing from one element to another. As explained in the article *RADIOACTIVITY*, the atoms of a whole series of radioactive elements were found to be breaking down naturally and changing into different kinds of atoms. This discovery led to man's breakup of atoms.

The nuclei of the heavier radioactive elements are the most easily split and produce the most energy. An isotope of uranium is the best for the purpose. Ordinary metallic uranium usually occurs as a mixture of three isotopes (varieties of the element with different atomic weights). They are U-238, U-235, and U-234; the num-

bers refer to the number of particles (protons and neutrons) in the nuclei. When an atom of U-235 is bombarded with slow-moving neutrons in an atom-smashing machine, the nucleus breaks up and gives off more neutrons. These split more atoms, which in turn release more neutrons. In this chain reaction huge quantities of atomic energy are liberated. Neutrons are used as "bullets" because, being uncharged, they are not stopped by electrical particles.

One of the serious problems facing the scientists working on the first atomic bomb (A-bomb) was to control a chain reaction once it had been started. Control was achieved in 1942 by a team of scientists working under Dr. Enrico Fermi at the University of Chicago. The scientists engaged in the atomic-research project also found ways to obtain enough U-235 to work with; this rare isotope has to be separated from the more plentiful U-238. In bombarding U-238 with neutrons released from U-235, the atomic scientists produced two elements never found in nature—neptunium and highly explosive plutonium. Plutonium was used in the bombs dropped on Japan in 1945. After World War II, atomic energy was utilized for other weapons and devices, such as cannon and engines for propelling submarines. (For peacetime uses of atomic materials, see ATOM SPLITTING).

Hydrogen Bomb. Destructive as the atomic bomb proved to be, it was far less destructive than the newer hydrogen bomb, or H-bomb. In this type of bomb, two atoms of hydrogen are combined to form one atom of helium. The combination weighs slightly less than the hydrogen atoms, and the lost mass is converted into energy of incredible power. The hydrogen atoms used are the heavy isotopes known as *deuterium*, with one proton and one neutron, and *tritium*, with one proton and two neutrons. When these are combined, they are said to fuse, and the method is called *fusion*. Deuterium, which is found in nature, was discovered by H. C. Urey and others in 1932. Tritium does not occur

naturally. Theoretically, the hydrogen bomb was known to scientists before the A-bomb was produced, but the temperatures needed to fuse the atoms existed only in the sun. The A-bomb, which generates millions of degrees of heat, is used as the trigger to set off an H-Bomb.

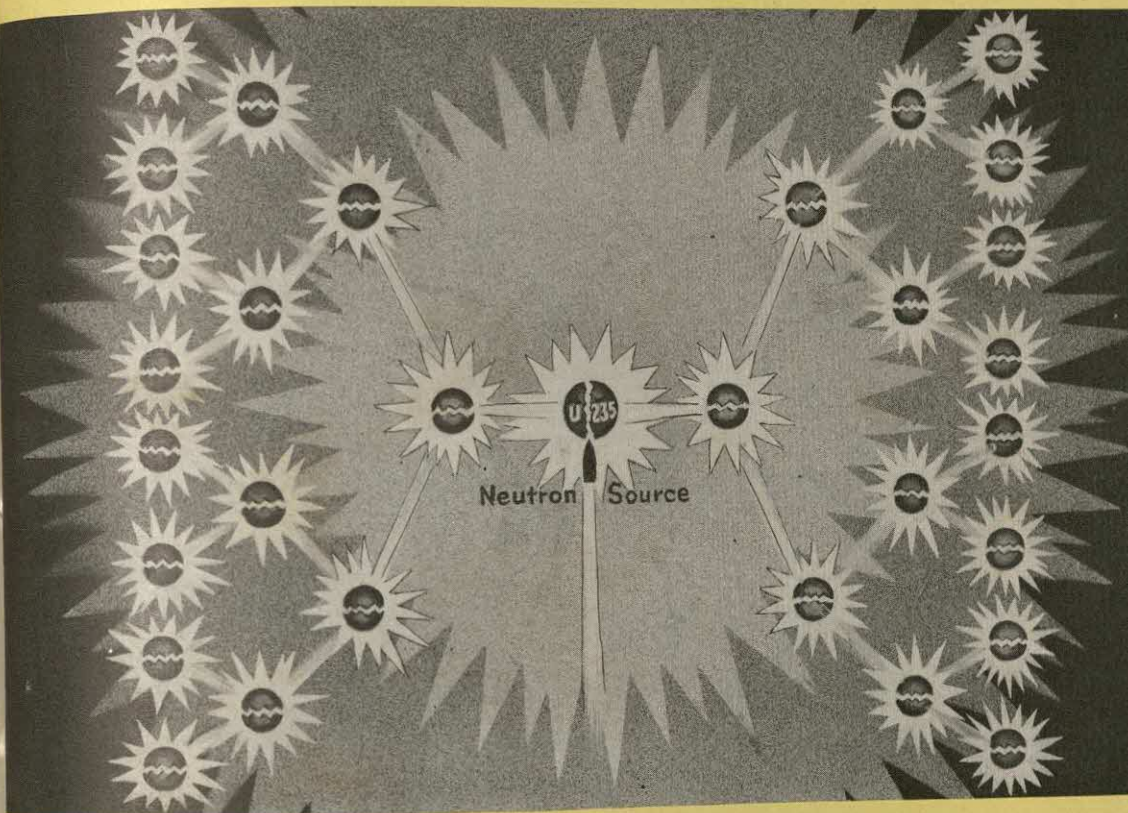
For further information, see:

Chemistry	Radioactivity
Electronics	Radium
Explosion	Rutherford, Ernest, Sir
Physics	Thorium
Plutonium	Uranium

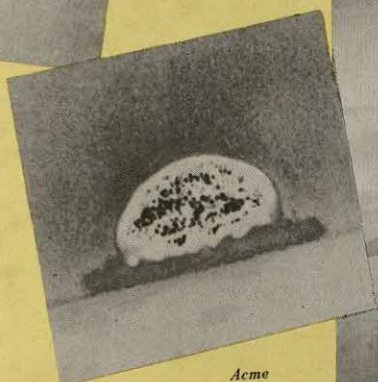
ATOM SPLITTING. Until the close of the nineteenth century, all atoms were believed to be solid and utterly incapable of being broken up. Scientists scoffed at the ancient alchemists who had tried to turn base metals, such as iron and copper, into gold and silver. Following the discovery of radioactivity in 1896 and the research of the Curies and other scientists, which proved that the atomic nuclei of certain elements are continually and spontaneously breaking down into other elements, scientists began trying to split atoms in their laboratories. In 1919 British physicist Ernest Rutherford succeeded. By bombarding nitrogen gas with the alpha particles shot out by radioactive elements, as they spontaneously change into other elements, he turned some of the nitrogen into oxygen. He had made the ancient alchemists' dream come true. Since then other scientists have invented various machines for splitting atoms. These include the cyclotron, invented by Dr. Ernest O. Lawrence at the University of California in 1931, the generator, cosmotron, synchrotron, betatron, and linear accelerator.

Atom smashers are used to make many elements artificially radioactive. They have been used to change ordinary table salt and cobalt into radioactive substances for use in treating cancer and other diseases. Such artificially radioactive substances are not only cheaper than radium and X-rays, but are also less dangerous, since their radioactivity is only temporary. Substances made artificially radioactive in atom smashers are also widely used as "tracers"

THE STORY OF *Atomic Energy*



Here is a picture of what happens in an atomic-bomb explosion. A neutron source breaks down an atom of uranium U-235, releasing further neutrons. Acting on other uranium particles, these neutrons touch off a chain reaction in which each successive nucleus is disintegrated.



Acme

These photographs, taken from a distance of six miles, show three stages in an atomic-bomb explosion. After a blinding flash, a vast cloud swells, spreads, and then soars skyward, creating a weird "mushroom" thousands of feet above the earth.

PIONEERING IN ATOMIC POWER POINTS TO A FABULOUS FUTURE



FIRST ATOMIC PILE
"LIGHTED" AT CHICAGO,
DEC. 2, 1942

OAK RIDGE
PILE, 1943



HANFORD
PILES, 1944

BROOKHAVEN
PILE, 1950



PLUTONIUM-
FUEL "FAST"
REACTOR, LOS
ALAMOS, 1946



LIQUID-FUEL
"WATER BOILERS,"
LOS ALAMOS,
1944 AND 1950



EXPERIMENTAL
BREEDER
REACTOR,
ARCO,
1951

OUTPUT OF PILES NOW BUILDING
AND UNDER DEVELOPMENT
ATOMIC POWER FOR VEHICLES AND
FOR GENERATING ELECTRICITY



PILOT-MODEL
POWER REACTOR
WITH LIQUID-
FUEL, OAK
RIDGE, 1952



SMALL LIQUID-
FUEL RESEARCH
PILES, 1952

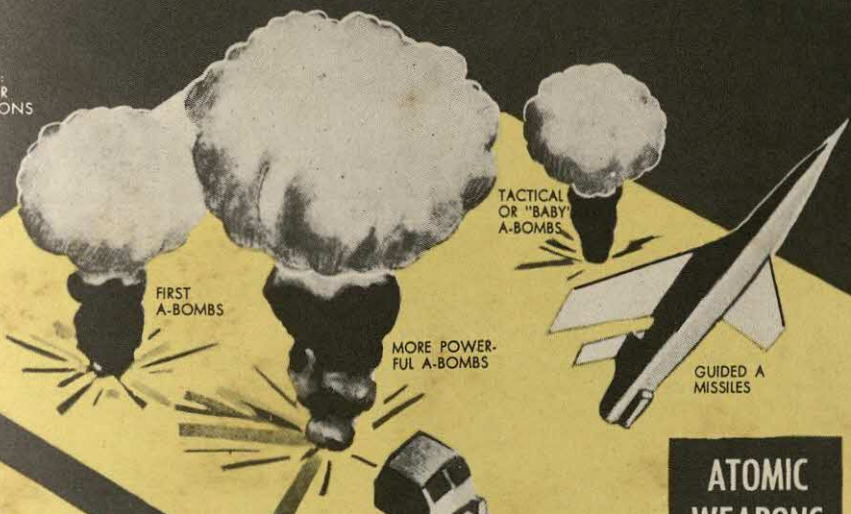


ATOMIC
ELECTRIC-
POWER
STATIONS

ATOMIC
POWER



OUTPUT OF
HANFORD PILES:
PLUTONIUM FOR
ATOMIC WEAPONS



FIRST
A-BOMBS

TACTICAL
OR "BABY"
A-BOMBS

MORE POWER-
FUL A-BOMBS

GUIDED A
MISSILES

ATOMIC WEAPONS

OUTPUT OF OAK RIDGE
AND BROOKHAVEN PILES:
RADIOISOTOPES FOR USE
IN THERAPY AND
AS TRACERS

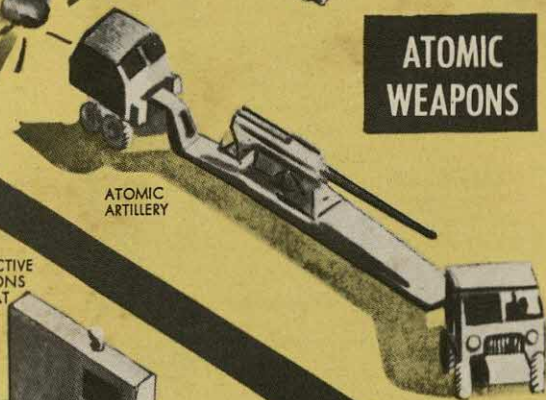


VIAL OF
RADIOISOTOPE
AS SHIPPED
TO USER

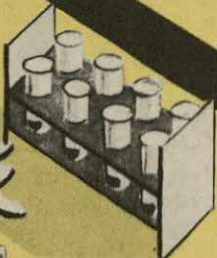


RADIOACTIVE
INJECTIONS
TO TREAT
DISEASE

ATOMIC
ARTILLERY



MEDICINE AND RESEARCH

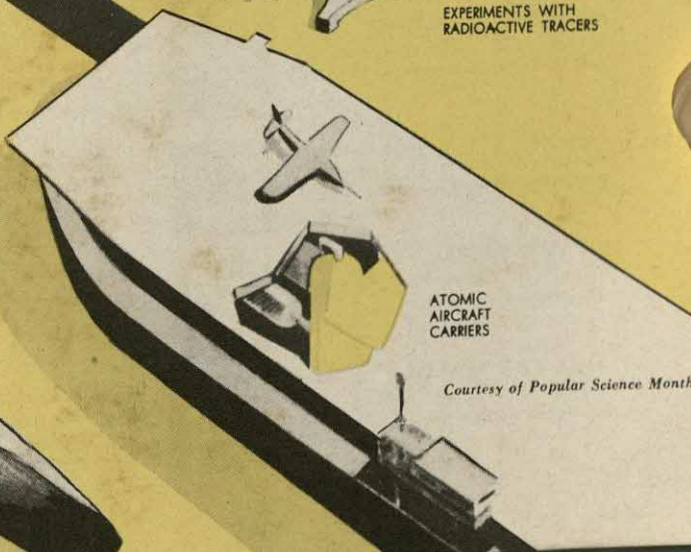


EXPERIMENTS WITH
RADIOACTIVE TRACERS

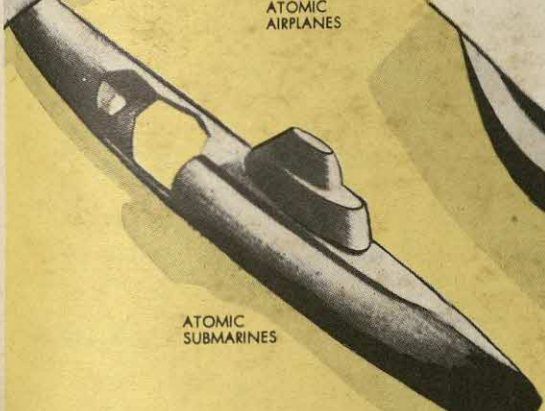
ATOMIC
AIRPLANES



ATOMIC
AIRCRAFT
CARRIERS



ATOMIC
SUBMARINES



Courtesy of Popular Science Monthly

THE LANGUAGE OF ATOMIC POWER

ALPHA PARTICLES. The charged cores of helium atoms that are emitted by radioactive materials.



ATOM. The smallest bit of matter retaining the properties of a chemical element.



BETA PARTICLES. High-speed electrons (charges of negative electricity) emitted by radioactive atoms.



CALUTRON. An isotope separator developed at the University of California; a modified form of cyclotron.



CYCLOTRON. The apparatus used to bombard atomic targets with particles accelerated in a spiral path.



DSM PROJECT (Development of Substitute Materials). The Army code name for the atomic-bomb project.



ELECTRON. A particle with a negative electric charge moving in an orbit outside the atom nucleus.



ELEMENT. A fundamental substance of unique chemical properties. Many have various types, called "isotopes."



FISSION. The splitting or disruption of an atom core, forming two or more other elements.



GAMMA RADIATION. Highly penetrating rays similar to X-rays but of shorter wave length.



HALF-LIFE. A measure used for comparing the life of radioactive materials without complete disintegration.



HEAVY WATER. Water that contains a double-weight isotope (deuterium) of hydrogen.



HOT LABORATORY. A laboratory for remote-controlled work on highly radioactive material.



ISOBARS. Forms of two or more different elements that have the same atomic weight.



ISOTOPES. Types of an element, distinguishable from each other only by differences in atomic weight.



MASS SPECTROGRAPH. The instrument for separating isotopes, or almost identical substances.



MODERATOR. Material, such as carbon or heavy water, that slows but does not absorb bombarding neutrons.



NEPTUNIUM. One of the newly created radioactive elements. It has an extremely short life.



NEUTRON. Particle in atom core carrying no electric charge. It is useful for smashing other atom cores.



NUCLEUS. The core of an atom, which is destructible by a bombardment of neutrons.



PILE. A built-up block, in a lattice pattern, of uranium embedded in graphite; used to manufacture plutonium.



PILOT PLANT. A small-scale factory where laboratory processes are tested before building a big plant.



PLUTONIUM. Newly created radioactive element of comparatively long life. Explodes, releasing atomic energy.



PROTON. One of the principal kinds of particles in the atom core. It carries a positive electric charge.



RADIOACTIVITY. The spontaneous or artificially produced disintegration of chemical elements.



URANIUM. A metallic element and parent of radium series. Rare "isotope" U-235 releases atomic power.



in studying the functioning of the organs of the human body and the effect of foods and drugs upon them, and in studying plants, animals, and metals. See **ATOMIC ENERGY**; **RADIOACTIVITY**.

ATTILA. Called "the Scourge of God" because of his cruelty, Attila and his brother Bleda became the joint rulers of a number of barbarous European tribes about A. D. 433. After ruthlessly conquering other tribes, Attila had Bleda murdered, then set out to extend his domain. Before long, he ruled over most of northern Europe and northwestern Asia. Although he failed in his attempt to capture Constantinople, his Vandal, Ostrogoth, Frankish, and other followers ravaged the Balkans, and he forced tribute and concessions from Theodosius II, emperor of the Eastern Roman Empire.

Soon afterwards, in 451, Attila turned westward and invaded Gaul, but was defeated by a combined army of Visigoths and Romans at Orléans. Though forced to retreat, he again met the enemy at Châlons in one of history's bloodiest and most decisive battles. This defeat of Attila ended the rule of the barbarians in Western Europe. A year later, Attila led his Huns into northern Italy and threatened Rome, but was persuaded by Pope Leo I to spare the city. Attila died in 453.

ATTORNEY GENERAL. See **JUSTICE**, **DEPARTMENT OF**.

AU'DUBON, JOHN JAMES (1785-1851). "Father" of the American bird-protection movement, this famous bird lover and painter was born on the island of Haiti and was educated in France. After coming to America in 1803, he spent so much time wandering about in search of birds to study and paint that his general store went bankrupt. But the paintings which he took to England in 1826 were not only exhibited there and in Scotland but also published in *The Birds of America*, with 435 life-sized colored pictures. Later the paintings were also reproduced in *Ornithological Biography*. Returning to America, Audubon began working with Dr.

John Bachman on a book about America's four-footed animals. The National Audubon Society, devoted to promoting the protection of birds, has many branches in North America.

AUGEAN, *aw je'an*, **STABLES**. According to an old Greek myth, King Augeas of Elis kept his 3,000 oxen in a stable that had not been cleaned for thirty years. One of the Twelve Labors that Hercules was forced to perform as a punishment for slaying his wife and children was to clean these stables in a day—a task he accomplished by making the Alpheus and Peneus rivers flow through them. When Augeas refused to pay him a tenth of the herd, as promised, Hercules slew him. Today, working to improve bad conditions is often called "cleansing the Augean Stables." See **HERCULES**.

AUGSBURG, *owgs' boork*, **CONFESSION**. Hoping to reconcile the differences that had risen between Germany's Protestants and Roman Catholics during the Reformation, Emperor Charles V ordered the Protestants to present a statement of their beliefs before a diet, or meeting, of Protestant and Catholic leaders to be held at Augsburg in 1530. Although Martin Luther, the Protestants' greatest leader, was banned from the conference, he revised the statement drawn up and presented by Philipp Melancthon. When the emperor and the Catholics refused to accept its views, the two branches of the Christian Church separated completely. The Augsburg Confession, as the Protestant document is now called, is still the basis of the Lutheran Church's creed. See **REFORMATION**, **THE**.

AUGURS. Believing in signs and omens, the ancient Romans never began an important undertaking without first consulting the soothsayers who made up their College of Augurs in order to find out whether the time was right for a successful venture. The prophets, or augurs, were believed to be able to read the will of the gods and to forecast future events from such signs as thunder, an animal's

actions, or even the spilling of salt. They became very powerful, and by simply saying "alio die" (on another day), they could dismiss an assembly or postpone a war. Their prophecies were called auguries; their forecasts based on birds were auspices. Today the word augur means to *anticipate* or *foretell*.

AUGUST. When Augustus Caesar, Rome's first emperor, was asked to choose the month to bear his name, he chose the eighth one because it seemed to have brought him good luck. For the story of how it happens to have thirty-one days, see **CALENDAR**. In the Northern Hemisphere, August comes in summer; in the Southern Hemisphere, in winter. The month's flower is the poppy or gladiolus; its gem, the sardonyx.

AUGUSTA, ME. The capital of Maine since 1831, and a busy trading center, Augusta lies at the head of navigation on the Kennebec River, some forty miles from the Atlantic. Its industries include sawmilling, publishing, poultry processing, and the making of pulp, paper, textiles, and shoes. Founded in 1754, it has about 21,000 residents.

AUGUSTAN AGE. This, the greatest period of Roman literature, came during the reign of Emperor Augustus and was named for him because he encouraged literature. Writers who flourished at the time include Horace, Ovid, Livy, and Vergil. The name is also given to the English period that produced Addison, Steele, and Swift, and to the reign of Louis XIV.

AUGUSTINE, au' gus teen (AURELIUS AUGUSTINUS), SAINT (354-430). A thousand years after his death, the writings of this early leader of the Christian Church were being used as authority by both the Protestant and the Catholic leaders of the Reformation. Born in North Africa, he was educated at Carthage, where he entered into the vices and gay life of his time. In 383, however, he went to Rome and from there to Milan, where he came under the influence of Saint Ambrose and was converted to Christianity. Divid-

ing his goods among the poor, he returned to Africa and devoted his great enthusiasm and brilliant mind to the Church and to writing religious books. Two of these—his *Confessions* and *The City of God*—are among the best-known religious writings.

AUGUSTINE, or AUSTIN, SAINT. In 597 Pope Gregory I sent Father Augustine and forty other monks to introduce Christianity into England. Kindly received by King Ethelbert of Kent, they converted the ruler and are said to have baptized 10,000 of his subjects in a single day. Called "Apostle to the English," Augustine became first Archbishop of Canterbury in 601.

AUGUSTUS, CAIUS JULIUS CAESAR OCTAVIANUS (63 B.C. - A.D. 14). When Julius Caesar was murdered in 44 B.C., his youthful nephew and heir, Caius Octavius, who had been studying abroad, returned to Rome, his birthplace, to claim his inheritance and to avenge his uncle's death. Adding Caesar's name to his own, he first won a struggle for power with Mark Antony, Caesar's popular friend, and forced the Senate to elect him consul of Rome, which was then a republic. After coming to an understanding with Antony, he joined with him and the general Lepidus to form a ruling triumvirate. Once the republican army led by Caesar's murderers, Brutus and Cassius, had been defeated at Philippi, the three men divided the Roman world among themselves. Lepidus was soon dropped, and in 31 B.C., at Actium, Octavianus smashed the combined fleets of Antony and his beloved ally, the Egyptian queen, Cleopatra.

Thus Octavianus became master of the Roman world, and four years later he was made its first emperor, with the title Augustus, meaning *sacred*. Under his rule, Rome reached the height of her power and greatly expanded her domain. Having no son, Augustus was succeeded by his stepson, Tiberius. Christ was born during Augustus' reign. See **ANTONY, MARK; AUGUST; AUGUSTAN AGE; CAESAR, CAIUS JULIUS; CALENDAR; CLEOPATRA; ROME.**

AUK. This is the name given to a family of heavy-bodied swimming and diving birds of the Arctic seas. Auks are clumsy birds on land, but are expert in the water. Their legs are placed so far back on the body that the birds seem to stand upright on their tails. The wings are useless for flight, but are an aid in swimming. Auks nest in colonies, each pair taking care of a single large egg laid in a niche on the bare rock of some northern seacoast. In winter all species migrate southward. Both birds and eggs are taken as food by the natives of Arctic regions.



THE GREAT AUK,
NOW EXTINCT

The largest and most notable species of auk is now extinct. This is the great auk, or *gare fowl*, once occurring in great numbers in the North Atlantic, but so hunted that since 1842 not a single one has been seen, and the few specimens in museums are carefully preserved. It was as large as a goose and black and white in color.

The *razor-billed* auk is still found in considerable numbers in the Atlantic, breeding along the coast as far south as New Brunswick, and in winter taking to the open sea and wandering as far as the coast of Southern United States. This bird is fifteen to eighteen inches long and has a remarkably high and sharp bill.

The little auk, or *dovekie*, about eight inches long, is found in winter south to the coast of Northeastern United States and sometimes inland to the Great Lakes.

AURELIAN, LUCIUS DOMITIUS AURELIANUS (about 212-275). Although he was one of the great Roman emperors, Aurelian was of humble birth. He first rose to the highest rank in the army. After the death of Claudius II in 270, he was chosen emperor. He freed Italy from invading

barbarians and defeated the famous Queen Zenobia of Palmyra. After these victories he corrected many evils of the empire and restored order. He was murdered in 275 while leading an army against the Persians.

AURELIUS, MARCUS (surnamed *Antoninus*) (121-180). Called one of the "five good emperors of Rome," Marcus Aurelius ascended the throne in 161. In that same year a war broke out with Parthia, and did not end until 165. When this struggle was over, Aurelius was forced to pay some attention to the German tribes who were threatening the Roman state. His colleague, Verus, had died, and the sole command of the war fell upon the emperor, who, nevertheless, subdued the Marcomanni and other German tribes.

Meanwhile Faustina, the empress, was secretly plotting treason with Avidius Cassius, governor of Syria. Aurelius heard of the treachery and was called from his conquests of the Germans to put down this new rebellion. But before he reached Asia, Cassius was assassinated. After visiting Egypt and Greece, Aurelius returned to Rome, but soon new invasions of the Marcomanni forced him once more to go to war. He defeated them several times, but his strenuous activities had tired him and he died in the midst of the wars.

Marcus Aurelius was one of the most humane and cultured men ever to reign as emperor. He had received the finest education Rome could provide, and knew the learned men of his time. He formed a great love for the Stoic philosophy, which taught courage, self-control, temperance, and justice. Nevertheless, he persecuted the Christians severely. He believed, as did many other Romans at that time, that the religious ideas of the Christians were harmful to the state. Thus he justified his severity.

The *Meditations* are the only written work of Aurelius in existence today. They are full of beautiful passages and have been translated into many modern languages.



JANE AUSTEN

Her books have delighted generations of readers.

AURO'RA BOREA'LIS, or NORTH-ERN LIGHTS. The awesome light which we sometimes see in the northern sky at night is the *aurora borealis*. Brilliant streams of light climb toward the sky from a hazy line of cloud around the horizon. There is a similar light in the southern sky, called the *aurora australis*. It is seen by the people on the side of the globe opposite us. However, scientists have studied the northern aurora more closely than the southern.

The aurora does not always have the same appearance. Sometimes rays of light streams are seen, apparently in constant motion; sometimes scattered lights appear in the sky; at other times lights almost cover the heavens. The aurora also takes on different colors—white, pale yellow, green, or red. In the northern countries it lights up the earth and pierces the gloom of the long winter nights.

When electricity passes through air which is not so dense as that we breathe, it shows a scattered light stream which resembles the aurora. Therefore, scientists believe that the northern and southern lights are caused by the passage of electricity through the upper regions of the atmosphere, where the air is not dense.

It is believed also that there is a connection between the aurora and magnetism, for a magnetic needle is affected by the lights. See **ELECTRICITY; MAGNETISM.**

AUSTEN, JANE (1775-1817). The daughter of an English minister, Jane Austen led a quiet, uneventful, middle-class life. But she was alert and observing and studied the people about her with a shrewd eye for peculiarities. At an early age she began to write stories, at first for her own amusement and then for publication. She wrote six novels, of which the best known is *Pride and Prejudice*. The others are *Sense and Sensibility*, *Mansfield Park*, *Emma*, *Northanger Abbey*, and *Persuasion*.

In these books Miss Austen gives a delightfully humorous account of the life about her. Her work is unsurpassed as a faithful picture of early nineteenth-century customs and manners in England. She was born in her father's rectory in Steventon, and died in Winchester.

AUSTERLITZ, *ows'tur litz*. In a river valley which cuts through the Carpathian Mountains and forms a natural pathway from Poland to Austria lies Austerlitz, the scene of Napoleon's famous victory in 1805. The town is about twelve miles southeast of Brünn, in what is now Moravia province, Czechoslovakia. It was here that Napoleon with 70,000 men defeated the 85,000 men of the allied Austrian and Russian armies. The result of the battle was the Peace of Pressburg, signed by Austria and France on December 26, 1805. The population is over 4,000.

AUSTIN, STEPHEN FULLER (1793-1836). The settlement of what is now Texas began in 1821, when Stephen Fuller Austin led a number of United States citizens to the banks of the Brazos River and established a colony. The families settled on land which had been granted by Mexico to Austin's father in 1820. Their colonizing venture was so successful that Mexico became alarmed at the greatly increasing number of settlers. The Texans went to war to free themselves from Mexico, and

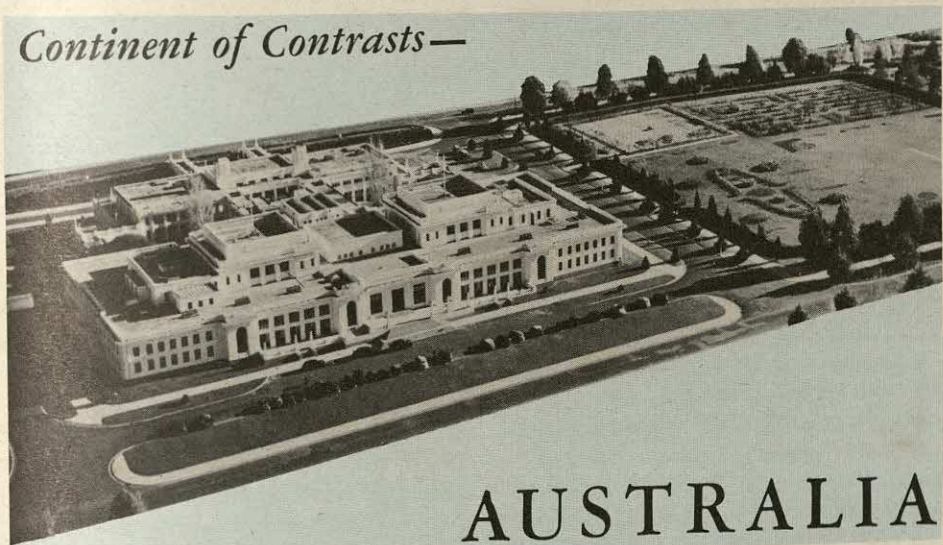
Austin, after briefly commanding their troops, went to Washington, D.C., to seek United States aid. In 1836 he was appointed secretary of state of the newly formed Republic of Texas, but he soon died.

AUSTIN, TEX., the state capital, named for Stephen Austin, founder of the first American colony in Texas in 1822. Austin has about 188,000 residents. Points of interest include the capitol and other state buildings, including those of the University of Texas. Its other educational institutions include St. Edward's University, Huston-Tillotson, and Lutheran Concordia colleges. Having excellent rail and air

service and fine motor roads fanning out in all directions, Austin is a distributing point for a large farming area. Its industries include the processing of foods, cotton, and leather, stone quarrying, and the making of furniture and bricks. Located on low hills and terraces along the curving Colorado River, Austin (first called Waterloo) was established as the capital of the Republic of Texas in 1839. It has been the state capital since Texas joined the Union in 1845.

AUSTRALASIA, *aws tral a' zha*. Part of Oceania, especially Australia and New Zealand. See OCEANIA.

Continent of Contrasts—



AUSTRALIA

AUSTRALIA, *aws trayl' ya*. Called "Down Under," Australia has its huge, prosperous ranches, great cities, and giant steel mills; and it is rich in gold and uranium. It is also a land of practically unexplored deserts and jungles, plants and animals native to no other place, and one of the world's most primitive races, its "aborigines," or native "blackfellows." In this South Seas land, where savagery and civilization meet, kangaroos bound under airplane wings and delay automobiles speeding along the paved highways. Australia is both the world's largest island and its smallest continent—the only inhabited continent

wholly south of the equator. Since its seasons are exactly the opposite of North America's, it celebrates Christmas in summer and harvests wheat in January.

Australia is also a country—the only one occupying an entire continent. In fact, this important member of the British Commonwealth of Nations overflows its continental boundaries, for the island of Tasmania is one of its states. Australia covers 2,974,581 square miles. Its area is more than three fourths that of Europe, but it has one fiftieth as many people. It has about 9,950,000 inhabitants, including about 47,000 aborigines.



Australian News & Information Bureau

VAST GRASSLANDS SUPPORT AUSTRALIA'S LIVESTOCK

Australia is world-famous for its sheep and cattle. Here a stockman cuts a steer out of a "mob" of Aberdeen-Angus. Mount Woolooma rises in the background.

The most isolated of the inhabited continents and, therefore, the last to be discovered by Europeans, Australia lies almost 2,000 miles southeast of Asia. Arms of the South Pacific, including the Coral, Timor, and Arafura seas, bound it on the north; the Indian Ocean, on the west; the Pacific, on the east; and these two merging oceans on the south.

The Great Barrier Reef, the world's largest coral deposit, skirts the northeast coast for some 1,250 miles. Though a ship-ping hazard, it creates a protected inner passage for coastal vessels. Its scenic, palm-fringed "Islands of the Sun," with their tropical beaches and fine offshore fishing waters, are also popular vacation playgrounds. See **BARRIER REEF, GREAT.**

Some 1,200 miles long, the continent's coastline is unusually regular, but is indented by the Gulf of Carpentaria, in the north, and the Great Australian Bight, in

the south. The country's best harbors are, however, made by its smaller gulfs, bays, and estuaries, the finest one being Sydney's. Others include Melbourne, Adelaide, Brisbane, Perth, and Hobart (Tasmania). Each of these ports is the largest city and the capital of its state. Darwin, the capital of the Northern Territory, also is a seaport.

The Land. At its largest points the mainland measures about 2,400 miles from east to west and nearly 2,000 miles from north to south. The Tropic of Capricorn crosses it, roughly dividing its northern tropical third from its southern temperate two thirds. The country's most populous and best-developed sections are the mainland's eastern, southeastern, and southwestern coastal plains and the eastern Tasmanian coast. Fertile and well watered, these areas contain Australia's best farming and dairying lands, finest orchards and vineyards, and all its big cities.



Australian News & Information Bureau

A YACHTING REGATTA IN SYDNEY HARBOR

Australians are a sports-loving people, fond of all sorts of outdoor recreation. The long coastline provides endless opportunity for swimming and boating.

Although the mainland's other coasts are mostly low, there are large sections in the northwest and south where hills drop sharply down to the sea and no streams flow into the ocean. These coasts, as well as the tropical northern one, are still largely undeveloped.

Inland from the eastern coast from 50 to 300 miles stretches the mainland's Great Dividing Range. Locally known by other names, such as the New England and Liverpool ranges and the Australian Alps, these mountains are so low that Mount Kosciusko, their loftiest peak and the country's highest point, rises only slightly over 7,300 feet above sea level. Yet the range is high enough to make the trade winds blowing in from the Pacific drop their

moisture on the eastern coast, giving it an abundance of rain, but keeping the interior very dry. It also forms the watershed dividing the rivers flowing eastward into the Pacific from those flowing westward, and contains many fertile valleys given over to farming and dairying. Here, too, are numerous scenic holiday resorts, including Mount Kosciusko, whose snowy slopes attract skiers.

On the west the mountains slope gently downward to form the continent's vast arid or semiarid interior plain. Lowest in the Murray River Basin of the southeast, the plain gradually rises toward the north and the west, where it ends in very low mountains. Scattered over the interior are other low ranges. Much of the interior of

Tasmania is a plateau traversed by low mountains, whose swift rivers make electric power for its industries.

Hot, arid lands make up about a third of the mainland. On some of these practically the only vegetation is stunted bushes; on others, mostly sandy, barren wastes, almost nothing will grow. The dreariest sections lie in the west-central portion, the so-called "dead heart" of Australia, where the Great Sandy, Great Victoria, and Gibson deserts stretch for miles. Although great herds of beef cattle roam the "bush," grazing on spinifex, saltbush, and other shrubs, few "drovers," or cowboys, are needed, even on the huge "stations," or ranches. Some of these are a hundred or more miles apart, a thousand miles from a sizable town, and larger than Massachusetts or Belgium.

To the north and east of the interior's arid lands are its semiarid areas. On the broad Great Plains of the east, a rolling savanna carpeted with long native grasses, large numbers of beef cattle are grazed. Farther south are many big irrigated wheat farms and sheep stations.

Waters. Australia's only large river system is made up of the Murray and its tributaries, the largest being the Darling, Lachlan, and Murrumbidgee. Rising in the eastern mountains, the Murray is about 1,200 miles long, drains a vast area in the southeast interior, and reaches the Pacific on the south coast. Its important irrigation and electric-power projects include the one around Hume Dam.

All the other rivers reaching the sea are short, and most of those in the interior simply evaporate in its burning sands or empty into salt lakes, many of which are only salt-encrusted depressions in summer. The largest lakes, in the southeast, are Eyre (nearly forty feet below sea level and the continent's lowest point), Torrens, and Gairdner.

Fortunately, the Australian interior has many huge basins of water lying under its surface. Reached by drilling artesian wells, some of which are thousands of feet deep,

and brought to the surface by windmill-driven pumps, this water makes stock raising possible on thousands of otherwise useless acres. See ARTESIAN WELL.

Climate. An unusual amount of sunshine and mild (in some sections, hot) weather the year round enable the Australians to be an "outdoors" people. Practically the only snow they ever see is on the highest eastern peaks, and there is no part of the country where stock cannot graze the year round. Although about a third of the continent gets under ten inches of rain yearly, and parts of the hot interior receive practically none, the well-populated coasts have an abundance and the always-hot tropical areas are very rainy and humid during the monsoon season. During the rest of the year (May through October) the tropics are dry and dusty.

Animals. Excepting the opossum, all the world's marsupials are native only to Australia. Among these strange animals that carry their young in their "pockets" are the kangaroo, wallaby, koala, wombat, bandicoot, Tasmanian devil, and Tasmanian wolf. Other unusual Australian animals include the dingo, or wild dog; the duck-billed platypus and echidna, the world's only egg-laying mammals; lung-breathing fish; and barking lizards. Ant-hills taller than a man are found in the tropics, as are crocodiles, wild buffaloes, and harmless pythons. Rabbits, whose ancestors were introduced by the colonists, are such serious pests that even the government wages a constant battle against them. The ostrichlike emu is the country's national bird. Other birds of interest include the lyre, bower, and mound-building birds, the kooka-burra, or laughing jackass, and many colorful cockatoos, parakeets, and parrots. See COCKATOO; DINGO; DUCK-BILLED PLATYPUS; ECHIDNA; EMU; KANGAROO; KOALA; LYRE BIRD; MARSUPIALIA; MOUND BIRD; PARAKEET; TASMANIAN WOLF.

Plants. Without its native grasses and shrubs, the interior could not support its flocks and herds. Also distinctive and wide-



THE ORIGINAL "TEDDY BEAR"

One of the queerest of all creatures, the koala of Australia resembles a midget bear, but is actually a cousin to the kangaroo. It is about twenty-four inches long and twelve inches in height, having soft, woolly ashen-gray fur and a button-like tail. The mother carries her young in a pouch, in the same manner as the kangaroo and opossum, and later the young ride on her back. Koalas have long toes and can grasp branches of trees easily, often sleeping back down, like the sloth. These little animals can easily be tamed, but native Australians kill and eat them. They live on shoots and buds of the eucalyptus trees and plant roots.

AUSTRALIA

The British dominion "down under" is the largest of the islands—the smallest of the continents. Almost wholly lacking in rivers, it must rely on its railroads, highways, and airways for internal transportation. The cities and towns on the eastern seaboard have been linked by rail with Western Australia since 1917. The great gap in rail transportation in Northern Territory is closed by a highway. Below: Australia is very sparsely inhabited, having only about one-twentieth the population of the United States in an almost equal area.





Australian News and Information Bureau

SHIPPING CROSSROADS OF THE SOUTH PACIFIC

The principal wharf area of Darling Harbor in the port of Sydney, Australia, is but a few minutes away from the main business district. Most of the wharves are leased to shipping companies. The city boasts one of the largest and best equipped harbors in the world.

spread are Australia's evergreen gums, or eucalypts, one of which is its national tree. Some of these are giant trees rivaling California's redwoods in height and growing in great forests. Besides furnishing "jarrah" and "karri," the world's sturdiest timbers, the country's eucalypts supply lumber, oils, gums, and wood for making furniture, paper, and other products. (See EUCALYPTUS.) Australia's national flower is the bright-yellow bloom of the golden wattle, only one of some 500 species of this acacialike plant found in the country. Much of the northern coast is a tropical jungle, where eucalyptus trees, mangroves, bamboos, tree ferns, palms, flowers, and other heat-loving plants grow in wild profusion. Other vegetation in-

cludes the pines, cedars, and softwoods of the temperate sections.

People. Nearly all of Australia's people are of British descent or birth. Moreover, its "white Australia policy" keeps it a white-man's country, barring colored immigrants. Although it usually welcomes white settlers, so many newcomers arrived immediately after World War II that it had to restrict immigration more than before. Australians are noted for being exceptionally progressive.

Australia's bronze-skinned natives are considered a separate race. Generally short, but sturdy, they have black hair, which is straight or curly, but never "kinky." In their wild state, as many of the natives remain, they are wandering tribesmen who



Chicago Park District; Ewing Galloway

EXOTIC EXPORT

Kangaroos, in the wild at right, are shipped from Australia to zoos all over the world.

go naked or wear very little, build no shelters but windbreaks, believe in devils, and eat their food raw, digging for roots, netting or spearing fish, and hunting for animals, birds, and reptiles. Their favorite weapon is their superior spear, but all except the Tasmanian natives also use the boomerang, which they invented (see **BOOMERANG**). For centuries these last survivors of the Stone Age were considered unintelligent, but that opinion no longer holds. Most of them now live on reservations in the arid interior or in the tropical north, but some work as cowhands, unskilled laborers, or even garage mechanics.



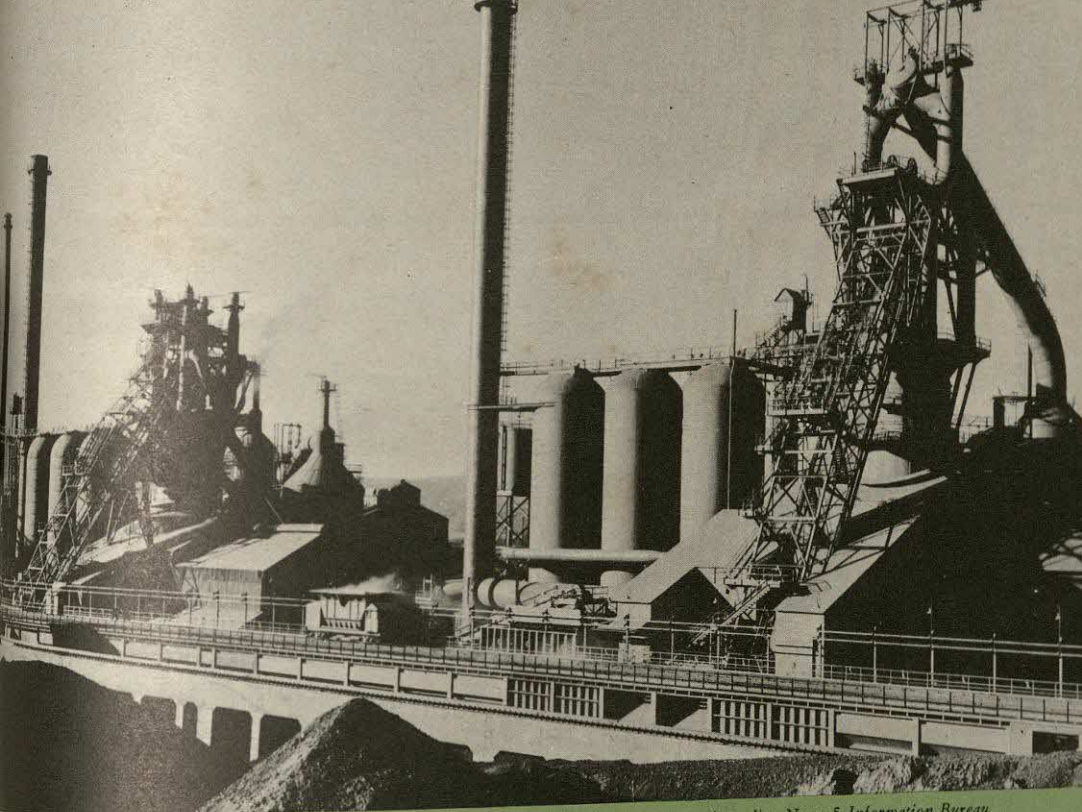
Stock Raising and Farming. Sometimes called the "Land of the Golden Fleece," this great pastoral country exports more wool, mutton, and lamb than any other nation. Like its dairy cattle, which provide large supplies of butter and cheese for export, its sheep thrive best in the cooler, well-watered areas. In the drier, hotter sections so many beef cattle are raised that their meat is another important export. Being so far away from Britain, its chief customer, Australia freezes most of its exported meats to keep them from spoiling. It also exports large numbers of skins and hides—from its sheep, cattle, wild buffaloes, kangaroos, crocodiles, and snakes. Hogs, goats, horses, donkeys, poultry, and even some camels are raised, too.

Although much of the country's prosperity depends upon its livestock raising, farming is also important, wheat being its chief field crop. Others include oats, barley, maize (corn), hay, rice, tobacco, and flax.

BIRD OR BEAST?

Here is the celebrated duck-billed platypus, egg-laying mammal.





Australian News & Information Bureau

IRON IN THE MUSCLES OF AUSTRALIAN INDUSTRY

The "good earth" in Australia not only favors agriculture but also yields great mineral wealth for industry. Here are blast furnaces smelting iron ore in New South Wales.

The northeastern coast, one of the few tropical places in the world where the work is done by white men, produces large supplies of sugar cane. Here, too, are grown cotton and tropical fruits, especially bananas and pineapples. Tasmania is called the "Apple Island" and is noted also for its potatoes and hops. Too, Australia produces large crops of citrus and various temperate fruits. Grapes, currants, and olives are important products.

Although more and more acres are being irrigated, and wheat is an important export, only slightly over 1 per cent of the land is farmed. Thus the stockman, not the farmer, is generally considered the "typical Australian," and sheepshearing time is the country's main "harvest time."

Manufacturing. Australia has also become a leading industrial nation since World War I, and especially since the start of World War II. This later conflict not only

cut it off from its foreign sources of supply, forcing it to meet its own needs, but also made it the logical producer of the war materials needed by Allied troops in the South Pacific. Its peacetime industries include meat refrigerating, fruit canning and drying, sugar refining, ore smelting, shipbuilding, and the manufacture of steel, automobiles, airplanes, locomotives, machinery, flour, wines, olive oil, textiles, clothing, leather, furniture, paper, chemicals, rubber, and electrical goods. Australia makes steel more cheaply than any other country.

Mining. Since payable gold was discovered in the east in 1851, Australia has been one of the world's chief producers of this metal. The largest gold nugget ever found, called the "Welcome Stranger" and weighing 2,315 ounces, came from Victoria in 1869. Although gold is now mined in every state in the Northern Territory, a large part



Australian News & Information Bureau

"FIRST CITIZENS" OF AUSTRALIA

When the white man first reached Australia, he found the continent populated only by aborigines like these three hunters, armed with long spears and throwing sticks.

of Australia's output comes from its southwestern deserts, especially from Coolgardie and Kalgoorlie. The latter's "Golden Mile," the world's richest gold-bearing square mile, has been producing since 1894. About four fifths of Australia's coal comes from the great deposits around Sydney. Broken Hill and other mining centers of the southeastern highlands are famous for their lead, silver, and zinc; nearby Iron Knob for its iron ore; and Tasmania for its copper. In 1953 large oil deposits were discovered on the west coast near Exmouth Gulf. Australia's other min-

erals include manganese, salt, gypsum, and alunite. It also produces tin, tungsten, and opals. The 1949 discovery of one of the world's richest uranium deposits in the "Rum Jungle," near Darwin, led to the immediate opening of mines there. When the United States began buying part of the output, Australians rushed into the tropical jungle in search of jobs and fortunes. Radium Hill, in the southeast, is another of the country's uranium fields.

Sea Products. Australia's encircling waters teem with fine food fish, but its principal ocean products are oysters, pearls,

pearl and tortoise shells, and *bêche-de-mer* (sea cucumbers). Many of the shells, taken off the country's tropical coasts, are exported to various countries. Picked up from the Great Barrier Reef's shallow surrounding waters, the sea cucumbers are usually sold to China.

Transportation. Coastal steamers haul much of the heavy freight between Australia's great cities, all of which are seaports, and the country has its merchant marine for carrying on its foreign trade. It is also connected with the outside world by airways, and planes link its cities with one another and with the hard-to-reach interior as well.

Each of the states has a railway system centering in its capital city, but the different gauges (width of tracks) make it necessary to transfer passengers and freight from one train to another. This results in delays and inconveniences, and also increases the cost of transporting goods by rail. Although Australia has some 28,000 miles of railway, mostly government-owned, there is only one transcontinental line; it links Perth, on the southwest coast, with Adelaide, on the southeast coast. A north-south line, to join Darwin and Adelaide, is still unfinished, but a bitumen highway links the railheads at Birdum and Alice Springs. Thus large areas of the country, including even the Great Plains, with its ranches and farms, have little or no rail service. Australia has some 500,000 miles of roads. But, like its railroads, most of its paved highways are in the well-populated areas. Elsewhere many of the roads are little more than rough trails, but the government is gradually increasing its paved-highway mileage.

Government. The Commonwealth of Australia is a union of six states and two territories. The states are New South Wales, Victoria, Queensland, South Australia, Western Australia, and Tasmania; the territories, Northern Territory and the Australian Capital Territory. The latter, set aside in 1909, contains the nation's capital, Canberra. Designed by W. Burley

Griffin, a Chicago architect, this beautiful garden city was formally opened when Parliament first met there, in 1927.

A self-governing member of the British Commonwealth, Australia has its own popularly elected Parliament, composed of a Senate and a House of Representatives. The Governor-General, appointed by Britain's ruler, is nominally its chief executive, but the Prime Minister, chosen by the controlling parliamentary party, and his Cabinet actually administer the government. Each state has its own elected parliament and a Crown-appointed governor. Voting for state and Federal parliaments is compulsory for all Australians over twenty-one years old, and Parliament may not restrict their voting powers. Australia has its own courts, but England's Privy Council may review certain acts of its Federal Supreme Court.

Australia is noted for its progressive social legislation, its successful handling of conflicts between capital and labor, and the steps it takes to advance the development of the country and its industries. For example, it maintains a "Flying Doctor Service" between base hospitals and farms in the sparsely settled areas, each of which is supplied with a radio transmitter-receiver.

The Commonwealth administers Papua, Norfolk, the Cocos, Heard, and McDonald islands; the United Nations trusteeships of New Guinea and Nauru islands; the Territory of Ashmore and Cartier islands; and the Australian Antarctic Territory.

History. A Dutch ship landed on the east coast of Australia in 1606, and from 1664 until about 1850 the continent was known as New Holland. In 1770 James Cook reached the east coast, claimed the territory for Britain, and named it New South Wales. In 1788 the first settlement was founded on Botany Bay (now in Sydney) as an English penal colony. Important discoveries of gold—in the east in 1851 and in the west in the 1890's—did much to spur settlement and development.

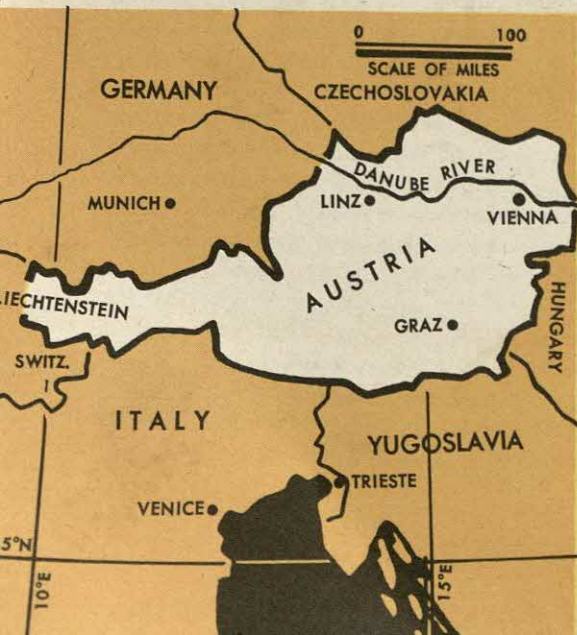
Australia's present states were separate British colonies until 1901, when they united to form the Commonwealth of Australia. The nation valiantly supported Britain in World Wars I and II and suffered the first attack in its history during the latter conflict, when the Japanese bombed Darwin and threatened to invade the continent. In the fighting in the Pacific, Australia not only contributed courageous fighting men but also served as an invaluable Allied base. The Commonwealth helped to create the United Nations and took part in the Korean War. In 1951 it joined with New Zealand and the United States to form a Pacific defense alliance.

Also consult **BRITISH COMMONWEALTH**; **COOK, JAMES**; **MELBOURNE**; **NEW GUINEA**; **OCEANIA**; **SYDNEY**; **WORLD WAR (I, II)**.

AUSTRIA. This Central European republic is only about the size of Maine, covering 32,388 square miles, but it has some 7,000,000 people. Most are German-speaking Roman Catholics. Nearly a fourth of the people live in Vienna, the capital. Germany and Czechoslovakia bound Austria on the north, Hungary bounds it on the east, Yugoslavia and Italy on the south, and Switzerland and Liechtenstein on the west. Austria, with its Alpine ranges and foothills, is landlocked, but the Danube River carries its goods to the ocean, and makes

AUSTRIA AS IT IS TODAY

This was once the hub of a mighty empire.



Linz and Vienna busy ports. International airways, railroads, and motor roads link the country with its neighbors and the world. Mountain streams and waterfalls provide hydroelectric power for most of its railroads and factories.

An industrial nation, Austria manufactures a variety of iron and steel products. The heavily forested mountains are a source of lumber and wood pulp and contain iron ore, coal, magnesite, copper, lead, zinc, salt, graphite, and bauxite. There are some oil wells. Although about a third of the people engage in agriculture, mountainous Austria must import some of its food. Major crops include grains, sugar beets, and potatoes. Dairying is very important, and considerable livestock is raised. The mild winters, cool summers, and beautiful scenery make the tourist business one of the country's leading industries.

History. For Austria's history before 1918, see **AUSTRIA-HUNGARY**. Refused permission to unite with Germany after the Allies' victory, Austria became a republic in 1918 but fell into bankruptcy and in 1934, under Engelbert Dollfuss, it became a semi-dictatorship. Dollfuss was assassinated soon afterward for opposing the union of Austria with Nazi Germany. His successor, Kurt von Schuschnigg, also tried to keep Austria independent, but in 1938 Hitler's troops occupied the country, and it was made a German province, called Ostmark. As such, it entered World War II.

In 1945 the Allies liberated Austria, and its republican form of government was restored. The United States, Britain, France, and the Soviet Union set up four separate zones of occupation. The Russians balked attempts to arrange a final treaty, and the country remained divided and under foreign supervision in the postwar years.

Austria has a two-house Parliament and a President, popularly elected for a six-year term. A Chancellor, appointed by Parliament, and his Cabinet actually administer the national government.

See also **ALPS**; **DANUBE**; **VIENNA**; **WORLD WAR (I, II)**.

AUSTRIA-HUNGARY, or AUSTRIO-HUNGARIAN MONARCHY.

Before World War I changed the map of Europe, the second largest country on the continent was Austria-Hungary, with a population of more than 50,000,000. Its people included Germans, Magyars, Bohemians, Serbians, Croats, Moravians, Slovaks, Ruthenians, Poles, Rumanians, Slovenes, and Italians. Politically the Dual Monarchy had no unity. There were really two separate administrations, one for Austria and another for Hungary. The ruler was emperor of Austria and king of Hungary. Austria and Hungary had separate Parliaments, and in Hungary the royal power was limited.

Austria-Hungary's History. Shortly after the birth of Christ, the country became a province of Rome; and in the year 796 Charlemagne annexed it to his fast-growing empire. It was ruled by nobles until 1282, when Rudolph of Hapsburg seized control, but in the meanwhile it had been overrun by the Hungarians in 900. It was about the tenth century that the name *Oesterreich*, meaning *eastern country*, was first used. The name of Austria is derived from this word.

From 1282 until 1918, the Hapsburgs held the throne of Austria. This long period was a bloody one, notable for the saving of Vienna from the Turks in 1683 by John Sobieski; the forcing of Hungary to acknowledge Austria as its ruler in 1687; and the alternating gains and losses of territory in the Netherlands, Germany, and the Balkan countries.

From 1815 to 1848, Austria opposed the creation of a German Empire, and thus lost some of its leadership among nations. Uprisings in 1848 resulted in a free press, the right of citizens to bear arms, and the

end of Prince Metternich's power. At this time, too, Austria opposed a unified Italy. In 1867 the Hungarians won the right to have their own government, creating the Austro-Hungarian Monarchy that existed until 1918.

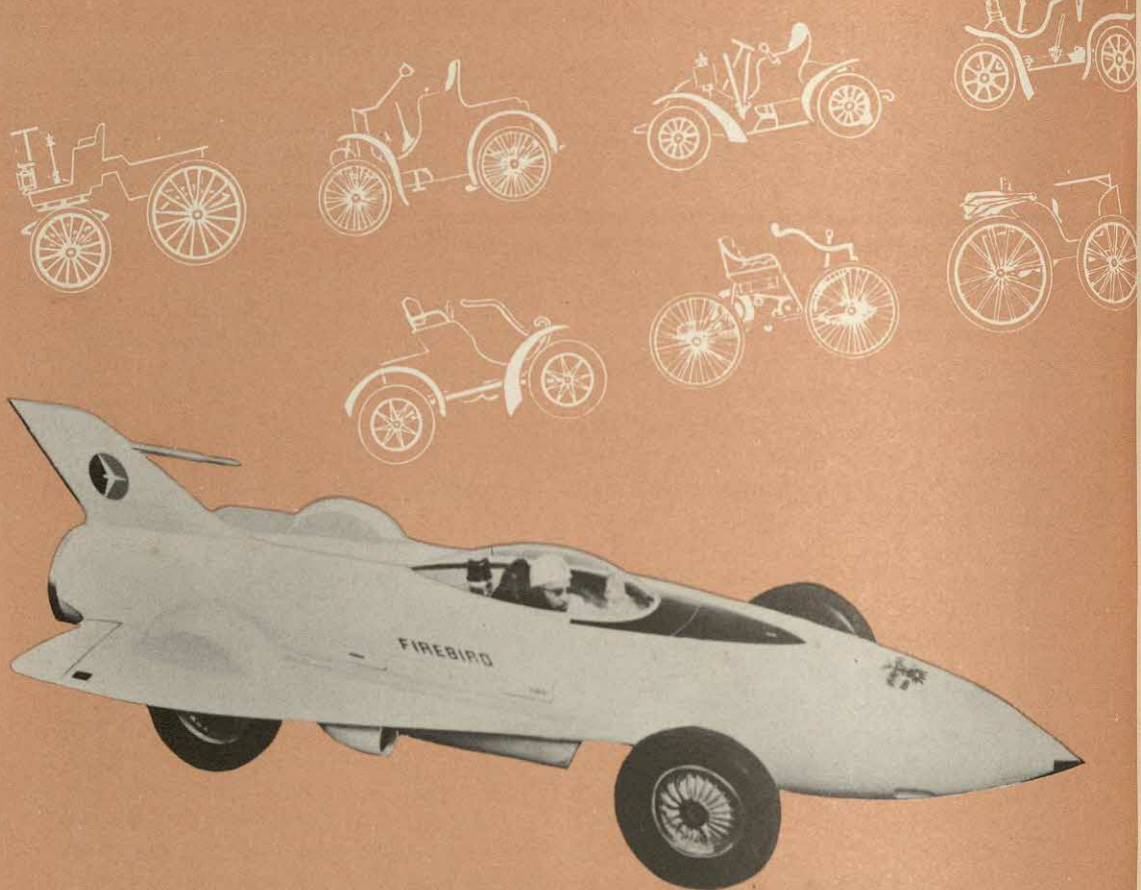
The assassination of Archduke Franz Ferdinand, nephew of Francis Joseph and heir to the throne of Austria-Hungary, on June 28, 1914, was the direct cause of the first World War. Because the assassin was a Serbian student, the empire resolved to punish Serbia severely. It declared war on July 28, and Europe was soon a battleground.

Only the Germans and the Magyars of the empire wished to side with Germany in the war, and throughout the conflict Austria-Hungary was plagued with revolts and strikes. Charles I succeeded to the throne when Francis Joseph died, in 1916. Conditions grew worse, and it appeared that the nation would split up. Finally, in 1918, the end came. Charles abdicated, ending the 636-year reign of the Hapsburgs. Few countries have had a more turbulent history than had Austria-Hungary.

Division of the Empire. After the war, the treaty makers attempted to divide the Austro-Hungarian Monarchy in such a way that each racial group would be in one country. Austria, mostly German, formed the "German State of Austria"; Hungary, the land of the Magyars, became independent; the Bohemians, Moravians, and Slovaks formed Czechoslovakia; and the Serbs, Croats, and Slovenes created the kingdom of Yugoslavia. Other parts of the old empire were divided among Italy, Poland, and Rumania. See AUSTRIA; WORLD WAR I.

KITZBÜHEL, A PICTURESQUE TOWN IN THE AUSTRIAN TIROL





International News Photo

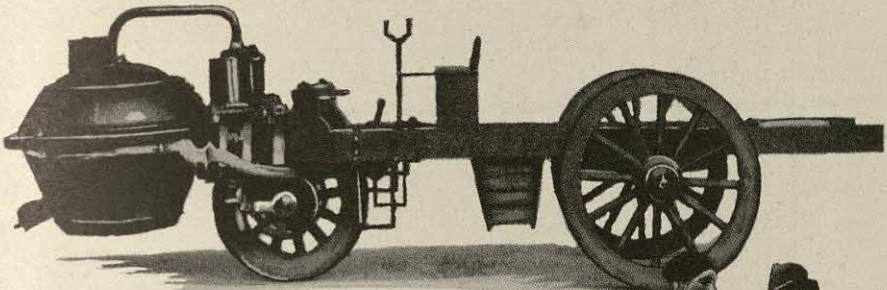
AUTOMOBILE, *aw to mo beel'*. No longer restrained by railroad timetables, no longer limited by the eight-mile-an-hour gait of horses, the automobile traveler of today makes light of time and distance. Able to go when and where he wants, at sixty miles or more an hour, he has become a modern, high-speed nomad. A trip downtown, or a journey of 3,000 miles across the continent, is his privilege and pleasure; he is a mechanized Aladdin with a car key for a magic ring!

Influence of the Automobile. Throughout the world, and especially in America, the automobile has exerted a tremendous influence. People living on farms and in tiny hamlets no longer are forced to stay near home. County and state have been drawn into their market and travel areas by the motor car and better highways. Merchants can ship their goods anywhere, by automobile trucks, disregarding the

limited delivery points of railroads and boats. Workers live miles away from the stores and factories where they are employed and still are not handicapped. Vacation spots far from civilization and the railroad are now easily accessible to the pleasure seeker.

The automobile has brought city and country closer together. One travels freely from one to the other, in safety and in short time. In like manner, the farm has been brought nearer to the market. Trucks deliver implements to the farmer; the farmer can ship his grains and perishable merchandise swiftly by motor. Distances everywhere have become shorter because of the automobile.

There is hardly a phase of American life that has not been affected by the motor car. Available to nearly all classes of people, the automobile has changed home, school, and church life, methods of



ANCESTORS OF OUR MODERN AUTOMOBILE

The Cugnot steam carriage (above) moved along the highway at 4 miles an hour in the 1760's. Henry Ford's gasoline automobile (below) was invented 150 years later.

recreation, distribution, and advertising. It has created new problems in lawmaking and administering justice, and has altered the future planning of great cities.

In addition to bringing about all these changes, the automobile has enabled people to gain a better understanding of their fellowmen. The freedom which the automobile gives to travel has allowed us to see new places and different people, to find out what others think about and what they are doing. The life and problems of the Manhattan banker are more quickly comprehended by the Muskegon clothing merchant, the citizen of Los Angeles becomes acquainted with the Little Theater movement in Dorset, Vt., all through the inviting ease of rapid, flexible automobile transportation.

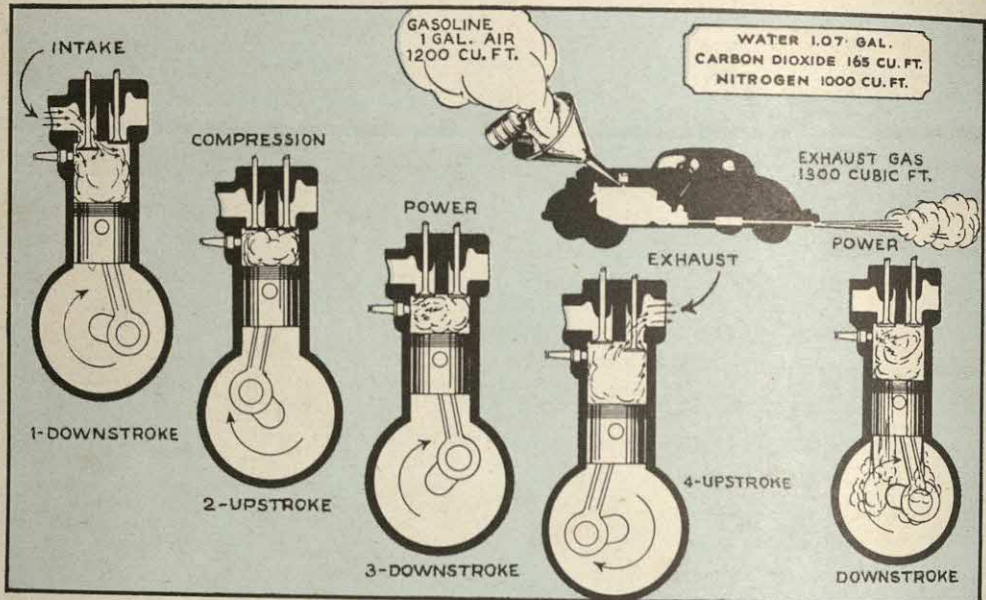
The effect of the automobile on industry may be likened to a quiet pond's low ripple grown into a tidal wave. Every field of industrial science and economy has responded to the demands of this one-time luxury, which has become a giant of necessity. Ten per cent of the total retail trade of the United States comes from the manufacture of automobiles and associated crafts. Such industries as the manufacturing of tires, steel alloys, safety glass, synthetic chemicals and plastics, upholstery, lumber, machine tools, measuring and testing instruments, fuels, spark plugs, and radios are either wholly or largely dependent on the motorist's progressive moods. It has been estimated that the bed and



board of one out of every eleven persons in the United States is paid for directly or indirectly by the automobile.

How the Automobile Grew. Although we can trace the history of the automobile as far back as 130 years before Christ, when Hero of Alexandria built the first steam engine, the modern motor car dates from the invention of the gasoline-explosion engine in 1880. This motor was based on earlier steam-model experiments by physicists Christian Huyghens, in 1680, and Denis Papin, who developed the steam piston and cylinder applied to moving a carriage ten years later. One year before the gasoline-explosion engine came into being, the first patent for the manufacture of automobiles in the United States was taken out by George B. Selden.

In 1885 Gottlieb Daimler, a German, perfected a method of making motors in quantity, using the principle of gasoline



Courtesy Popular Mechanics

PUSHES AND PULLS THAT MAKE THE MOTOR RUN

This diagram shows what happens to gasoline-air mixture when it passes through the engine.

vapor explosion, and seven years later Charles and Frank Duryea built and drove the first American-made automobile. Henry Ford, who was to place the automobile where it would be available for people of all walks of life, built and ran his first car in Detroit in 1893. The chambered spark plug was developed in 1898 by Frank W. Canfield, and the electric starter was first installed in an automobile in 1911.

Automobiles have changed much in appearance and performance since these early days, but the engines have remained basically the same. The bodies, which once were carriages, have been lengthened, lowered, strengthened, and streamlined until now there is little resemblance between the queer-looking buggies that people used to laugh at, and the trim, fast, and smooth vehicles that roll over our streets and highways. Improvements in motors have made them faster, more powerful, and reliable. Brakes, safety glass, steel, and sturdy tires have given us safety.

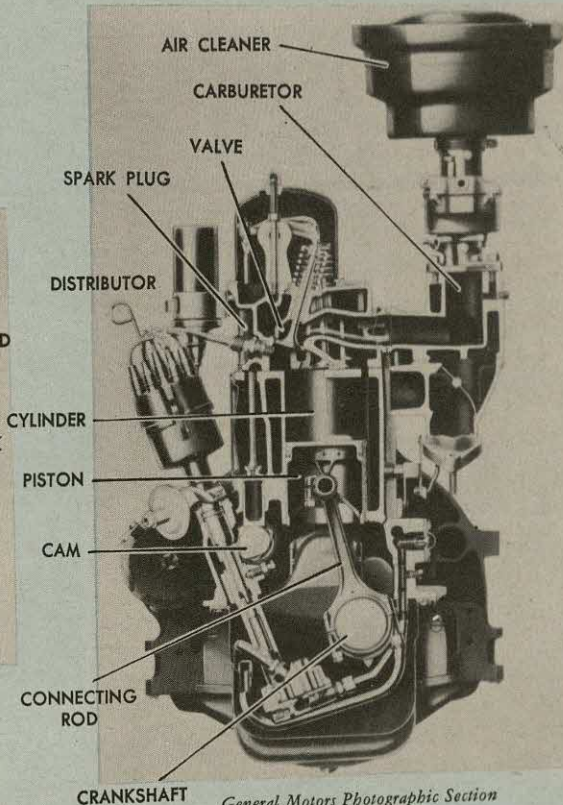
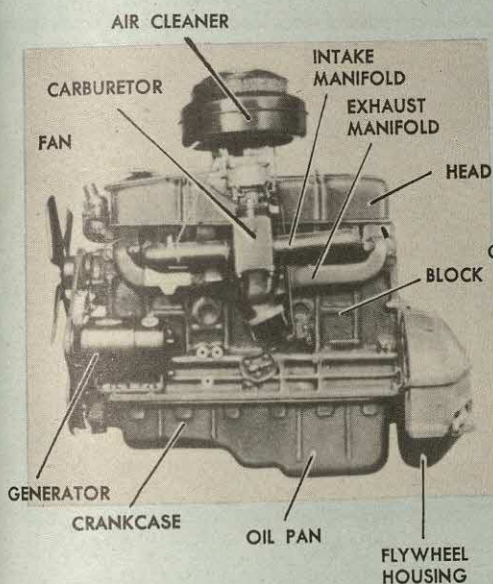
Yet none of the comforts of the automobile would have been available to the

mass of American people had it not been for gasoline. Electric- and steam-driven automobiles had been manufactured, but they were not satisfactory. Automobiles and petroleum have grown up together, each dependent on the other.

What Makes It Go. If you have ever examined a bicycle pump you have noticed that it consists of a cylinder and a plunger. The gasoline motor also has a cylinder; in fact, as many as four, six, eight, twelve, and even sixteen. The plunger, however, is called a piston, and it moves up and down in the cylinder just like the plunger in a pump. It is connected by a rod to the crankshaft, which changes the up-and-down motion of the piston to a circular motion that rotates the gears. This rotating motion is carried to the rear wheels, where the automobile is propelled.

At the top of the cylinder in the motor are two valves, one to admit the mixture of gasoline vapor and air, and the other to let the burned gas out. As the piston moves downward, the suction of the piston draws the gas and air through the inlet valve into the cylinder. The valve

PARTS OF AN AUTOMOBILE ENGINE



General Motors Photographic Section

WHAT MAKES THE WHEELS GO 'ROUND

At left is a side view of an automobile engine. At right is a head-on view of the engine in cross section. The principal parts are identified by the labels.

closes as the piston ascends and squeezes the gas mixture. As the piston nears the top of the cylinder, a spark given off by the spark plug explodes the gas, driving the piston down.

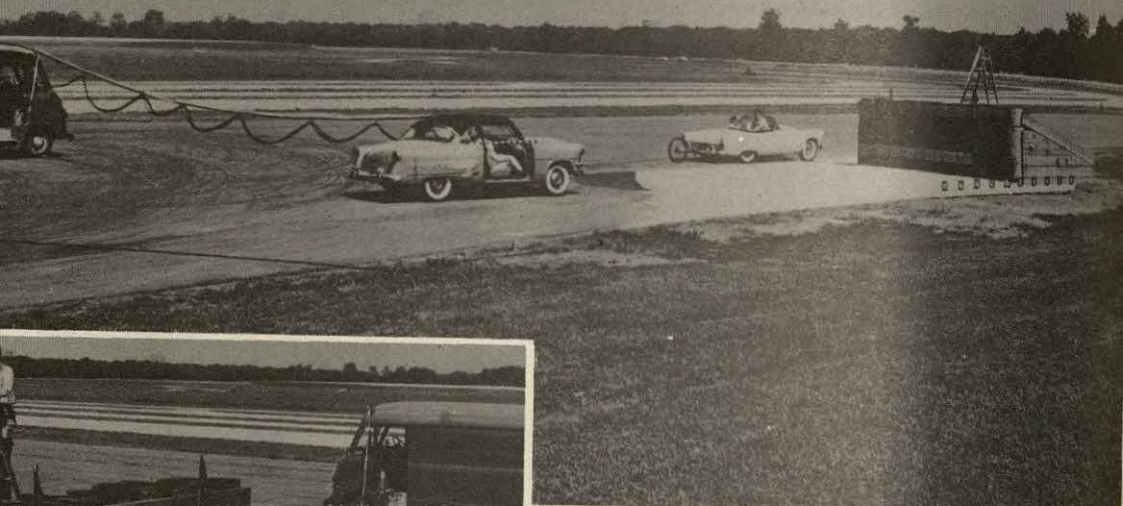
As it goes down, the crankshaft turns, the outlet valve opens, and when the piston rises again, the burned gas escapes through the valve and out of the exhaust pipe. This *cycle*—sucking in, squeezing, burning, and forcing out of the gas—happens in far, far less time than it takes to tell it, and when it occurs in four, six, eight, or twelve cylinders, it may be seen why the motor is able to go as fast as it does.

The speeds of the automobile are regulated by the gears. The largest gear is the slowest, and is called *first*; smaller, and faster, less powerful is the *second* gear, while *third* or *high* gear is the smallest, fastest, and least powerful. *Reverse* is the

set of gears changing the direction of the rotation, and is the slowest but most powerful of all the gears. Cars may also be equipped with a fourth forward speed, or *overdrive*. The difference in power in the various gears makes it necessary for a driver to shift back into second or even first when ascending a very steep hill. Shifting may be manual or automatic. In manual shifting, the driver uses the *clutch* to prevent injury to the gears.

The automobile is steered by a rod connecting with the front wheels. A sufficient supply of oil is necessary to keep all the parts of the motor running smoothly and without friction, while water in the radiator keeps the motor from becoming too hot. The fan helps to keep the water cool.

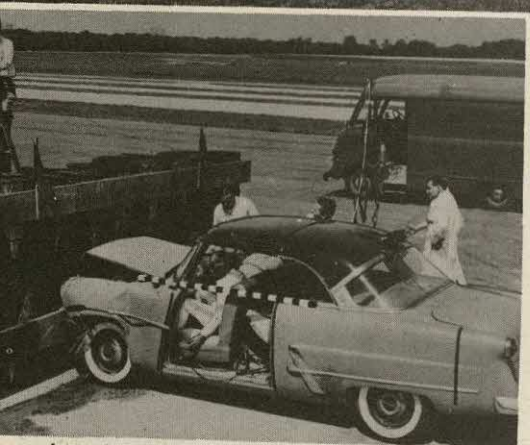
From Chassis to Highway. When automobiles were new, there were any number of companies making them. But, as time went on, these companies were com-



Ford Motor Company

A CRASH TO SAVE LIVES

Safety engineers tow a car into a crash barrier (above) while instruments in van at left register results of impact. Dummies in car (left) are used to test effects of crash on human body.



bined into bigger ones, and today in the United States there are only about a dozen firms making all the different types of automobiles we see on the highways. So great has the manufacture of automobiles become that today it is one of the foremost industries of the United States, the value of automobiles each year running well over a billion dollars and sometimes above two billion dollars. About 600,000 persons are employed directly in the manufacture of automobiles.

The foundation of the automobile industry is the assembly line where cars are put together. This is a movable, continuous platform, with men assigned to different tasks along the route of the line. The chassis of the automobile is first assembled, all the various parts being fixed by the workmen as it passes them.

At one place, the motor is lowered into position and deft fingers clamp it firmly in place. At another station, tires are placed on the wheels. Then come the body, the fenders, bumpers, lights, and all the various appliances that go to make up an automobile. Paint is sprayed on with guns, and dried quickly in an oven. Finally, the car is tested and driven "off the line" ready to be sold. This method of production has become so efficient that it is possible for a large automobile company at times to produce one car a minute.

Problems of the Automobile. In 1900 very few people drove automobiles. Today there is an automobile for every three persons in the United States. Such a rapid growth has, of course, created many difficult problems for our city, state, and national governments. Automobiles have been made to go faster and faster, and with this increase in speed there has been an increase in the number of people killed and injured each year. As a result, cities

have set up laws governing the speed of automobiles within their limits. Traffic regulations have been passed, governing the parking, turning, and direction of automobiles on streets. Stop-and-go signals, warning signs, and lines painted on streets have been placed to cut down the number of deaths and injuries.

Roads are being made wider, and heavily traveled highways are being built with partitions in the middle to prevent reckless driving. All states now give tests to drivers in order to prevent unqualified persons from driving. Courts fine and sentence reckless and fast drivers in order to teach other motorists that they cannot disobey the laws. Formerly, many accidents were caused by imperfections in the machines; even today, blowouts of tires and failure of other parts of the automobile frequently are the cause of crashes. But nearly everyone realizes now that automobiles are made safe and strong, and that they are usually not at fault when an accident occurs.

Looking Ahead. Each year sees new improvements in automobiles. Great automobile corporations employ staffs of trained men who develop new safety, speed, and comfort devices. One of the results of this research has been the streamlined automobile. As the years go by, even these designs are expected to change, and it is not improbable that cars of today may appear as quaint in twenty years as the vehicles of twenty years ago look now.

Another development that is expected to go forward is bus transportation. Many cities already have eliminated electric street cars and substituted buses. For trans-continental and long-distance travel, added comforts in the form of sleeping and eating accommodations are already available. Trucks, too, may be further developed in the years to come. Already they have become a major competitor of the railroads in carrying freight, and although they are slower over long distances, they are becoming increasingly useful on short hauls.

Still another use for the automobile has been found in the trailer. These movable small homes are convenient and cheap for vacationists, and by 1954 about two million Americans lived on wheels all year round. There are 700,000 "mobile homes" in the United States, many of which boast dishwashers and television.

For additional reading consult the following articles:

Carburetor	Gasoline
Diesel Engine	Horse Power
Gas Engine	Pneumatic Tires

AV'ALANCHE. Sometimes cattle, human beings, forests, and whole villages are buried beneath a falling mass of snow, ice, and earth, that breaks loose from a mountain slope and slides down with dreadful force, to crush and destroy. Such a falling mass is called an avalanche. There are several kinds of avalanches. Dust or wind avalanches are made up of fine, dry snow driven down the mountain by a strong wind, while the name sliding avalanche is applied to great snow masses that are carried down by their own weight. Those which break away from high glaciers because of heat are glacier or summer avalanches.

The sliding avalanche is the most dangerous. When tons of snow begin falling down from a great height, boulders, earth, and trees are carried along; and the mass and force of the avalanche increase with the fall. An avalanche which fell in the Alpine district of Italy in 1885 contained 250,000 tons of snow.

AVE MARIA, *ah'va mah re'ah* (*Hail, Mary*). When the angel Gabriel informed Mary that she had been chosen by the Lord to be the mother of Jesus, the first words he spoke were *Ave Maria*. The story is in the New Testament of the Bible, *Luke I, 28*. The words are also the beginning of the very common Latin prayer to the Virgin Mary in the Roman Catholic Church. The use of the prayer by others than priests was granted by the Pope at the end of the twelfth century. In 1326



THE MEDIEVAL SPLENDOR OF THE ANTIPOPE SURROUNDS AVIGNON

The many-arched building in the center was for many years the Palace of the Papacy, following the great schism at Rome. The town was incorporated into France in 1791.

the Pope ordered that the prayer be repeated three times each morning, noon, and evening, at the hour when the bells called the Ave Maria, or Angelus Domini, were sounded. This salutation has been the inspiration of several fine musical compositions.

AVIARY. In most zoos today there are aviaries, or large cages, in which all kinds of strange birds are kept and bred. Very often the birds live in surroundings much like their original homes. Aviaries have been known since the days of the Romans and have been in existence in England since the sixteenth century. At the present time, many cities of the United States and England support aviaries, located usually in public parks.

AVIATION. The art or science of locomotion in the air is known as aviation. See AIRPLANE; BALLOON; DIRIGIBLE BALLOON; FLYING, STORY OF.

AVIGNON, *a ve nyoN'*, FRANCE. One of the very old towns in Southeastern France is Avignon, situated on the east bank of the river Rhone. In the fourteenth century it became important because Pope Clement V moved there from Rome. The period during which the Pope stayed at Avignon is known as "the Seventy Years' Captivity." The town was the property of the Papacy from 1348 until 1791, when it became a part of France. The population is over 60,000.

Notre Dame Cathedral, begun in the

twelfth century, an arch bridge dating from the same period, and the Palace of the Popes were symbols of Avignon's long history. In World War II the old town was almost destroyed by bombs, but after the war its factories went back into production, turning out a variety of products, and surrounding peach orchards blossomed anew.

AVOCADO, *av o kah' do*. Sometimes miscalled *alligator pear*, the avocado is one of the most highly prized of the tropical fruits. It is native to Mexico and Central America, and perhaps also to Northern South America and the West Indies, where it is commonly grown. More recently it has been introduced into other tropical countries. It is grown commercially in Florida and California, where it is rapidly gaining in popularity.

The avocado is a beautiful shade tree, reaching a height of fifty feet, and having large, thick, green leaves, somewhat resembling the magnolia in appearance. The fruit varies greatly in size, being from one inch to six inches in diameter. Its thin skin varies in color, being green, purple, or crimson. In shape the fruit is spherical, oblong, or pear-shaped. The fruit is filled with yellowish, buttery pulp, surrounding a large, single seed in the center. The pulp is rich in oil, hence very nutritious, and is of delicious, nutty flavor. The flesh may be eaten fresh, much as cantaloupes are eaten, or it may be used in salads.

AVOGADRO'S, *ah vo gah'droze*, **LAW**.

This law of physics is named for Avo-gadro, an Italian scientist, who, in 1811, made an important discovery. The principle of the law is that equal volumes of different gases contain an equal number of molecules if the gases are under the same pressure and at the same temperature. Molecules are the smallest particles into which a substance can be divided without a chemical change. See **MOLECULE**.

AVOIRDUPOIS, *av ur du poiz'*. This word comes from old French words meaning *goods of weight* and is the name of a system of weights. Avoirdupois weight is used for measuring all goods except precious metals, gems, and medicines. In this system a pound contains 16 ounces, or 7,000 grains. In troy and apothecary weights, the pound has 12 ounces, or 5,760 grains. The grain has the same value in all systems.

AZORES, *a zorz'*, or **WESTERN ISLANDS**. Eight hundred miles west of Portugal, in the North Atlantic Ocean, lie nine volcanic islands called the Azores. The islands form three distinct groups: northwest, Flores and Corvo; central, Terceira, São Jorge, Pico, Fayal, and Graciosa; southeast, São Miguel and Santa Maria. Ponta Delgada is the chief town of the Azores, which are politically a part of Portugal. When they were discovered by the Portuguese navigator, Gonzalo Velho Cabral, in 1432, they were not inhabited. Shortly after Cabral's visit, the Azores were colonized by the Portuguese and today they still belong to Portugal.

Cone-shaped, high, and steep, the islands have scenic mountains. The highest summit is Pico—7,600 feet above sea level. With naturally fertile soil and a mild, moist climate, the islands are covered with a rich vegetation. There are many different kinds of trees, vineyards, lemon and orange groves, and rich, open pastures. The inhabitants are able to grow on this fertile soil everything needed for subsistence. The people of the Azores are mostly Portuguese and number around 320,000.

The first successful flight of an airplane across the Atlantic was the now famous adventure of the *NC-4*, of the United States Navy. It landed at the Azores in 1919. Since then the islands have been used as a stopping-off place for planes.



AZTEC ART

This fierce-looking figure is an example of early Mexican sculpture.

AZTEC. Conquered by Cortez, the white man they had thought to be a god, the Aztecs and the civilization they had built were swept into oblivion as the gold-seeking Spaniards invaded their lands in Central Mexico.

Long before the first European adventurers stumbled on American shores in their search for a westward route to India and Cathay, the Aztecs had developed a highly organized society. Their farmers raised maize and agave, and used a system of irrigation. There were metal workers, and potters. The patterns designed by these people are copied by weavers and builders of today. Inspired by their fierce religion, they erected great temples, resembling pyramids, in which they made human sacrifices to their gods. Their worship centered upon two gods, the god of war and Quetzalcoatl, kindly god of light and air, for whom they mistook the pale Cortez, with his mounted, armored soldiers. The Aztecs gloried in war and trained professional soldiers to do battle for them.

Nevertheless, while art and science was at its beginning in Europe, the Aztec cul-



HOW AZTECS MEASURED TIME

This work of art told the ancient Aztecs the day, month and year. It was a calendar as accurate as any yet invented.

ture was in full flower; priests, the learned men, were teaching the young, studying the stars, and devising a calendar based on the moon, which amazes modern scientists by its accuracy; and they were in-

venting the system of picture writing from which scholars today are reconstructing Aztec history.

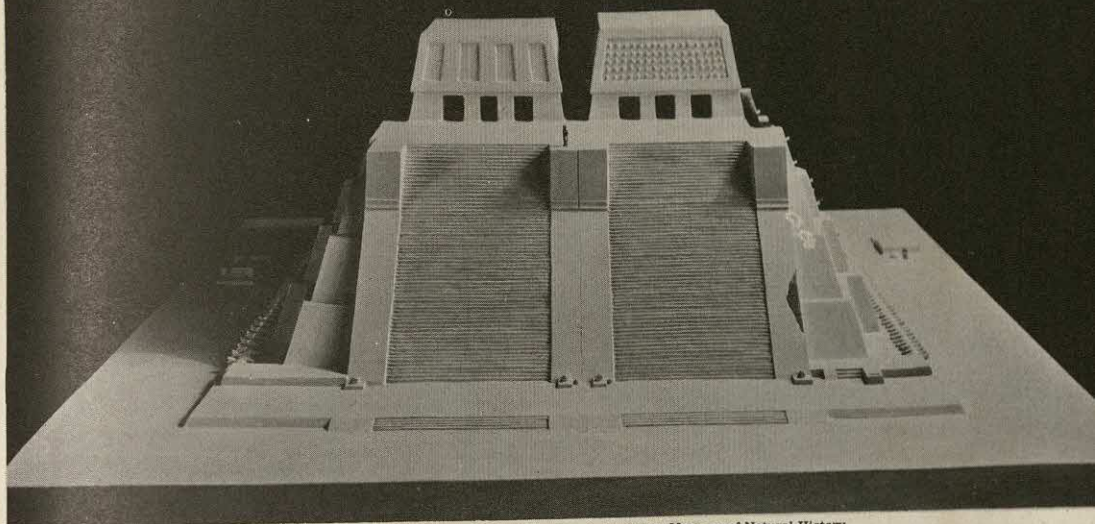
Then, at the height of their power under the famous ruler Montezuma II, the Aztecs at first trusted Cortez and did not resist him. And when they did give battle, they were vanquished by the little army of Spaniards after heavy fighting. So the years of the Cortez conquest of Mexico, 1519-1521, mark the end of the Aztec nation.

The deserted temples were forgotten for centuries. In recent years, however, explorers and students have been hunting traces of the ancient race and have found terraced stone pyramids with fantastic carvings—the fragments of a dead civilization. Of their epic story, there remain today only their descendants, the Mexican peons; Aztec names on the map, and remnants of their speech.



SERPENT SYMBOLS IN STONE

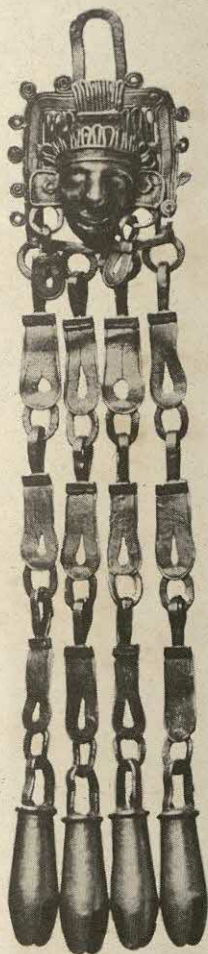
This Aztec turquoise mosaic snake is a precious relic of Aztec glory.



American Museum of Natural History

RELICS OF AN 800-YEAR-OLD CIVILIZATION

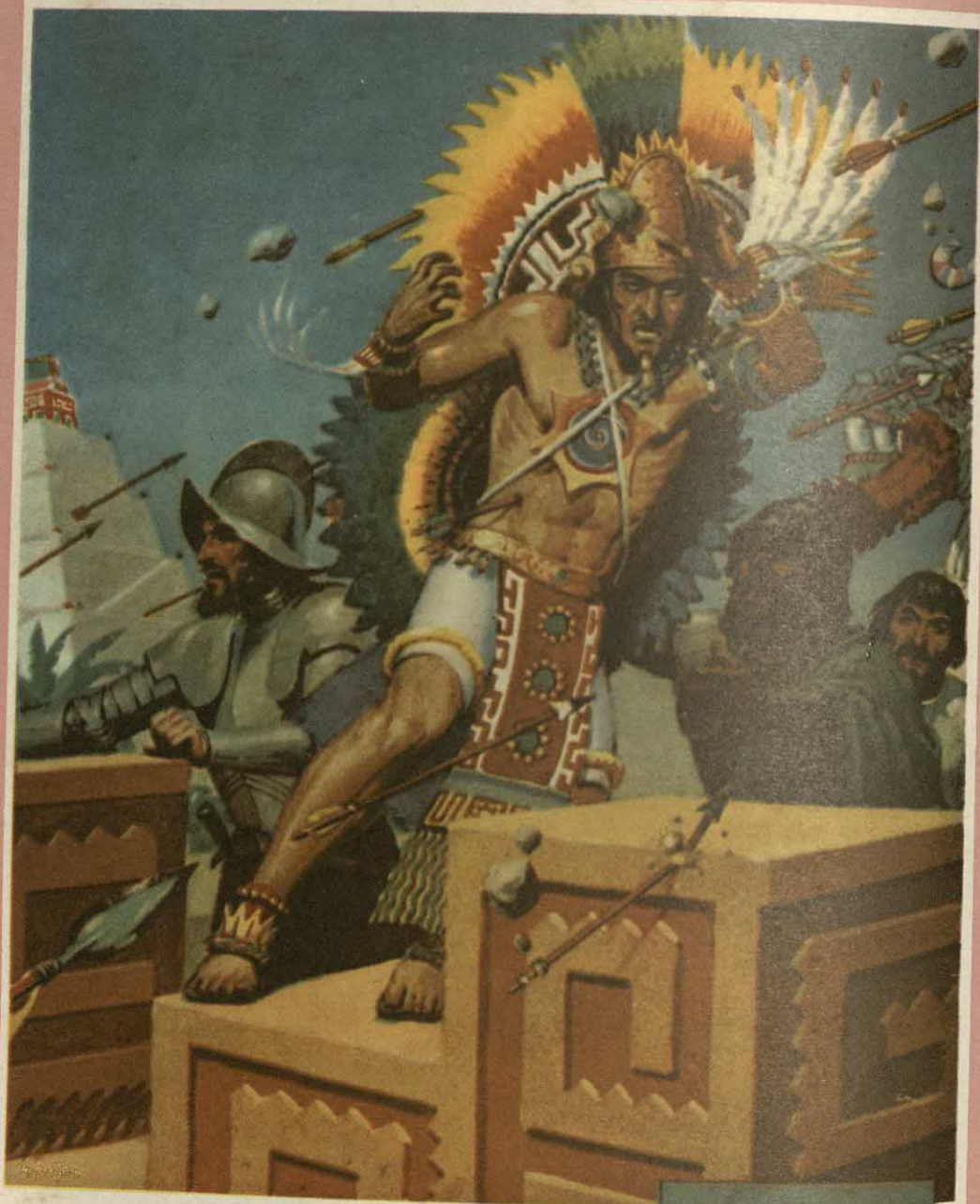
Model of an Aztec temple (above) at Tenayuca, Mexico, as seen from the front or northwest. The fierce, warlike Aztecs built many such pyramid-shaped temples, where they made human sacrifices to the gods of rain, sun, wind, and war. An intricate ornament of gold (left) reflects craftsmanship that rivals that of any age. Most of the jewelry was fashioned from gold, silver, or jade. The helmeted Spanish conqueror, or *conquistador* (below), was immortalized by an Aztec sculptor. The Aztecs disappeared as a civilization after their defeat by Cortes in 1521. Many of their descendants still live around Mexico City, once Tenochtitlán, capital of the Aztec empire.



Museo Nacional



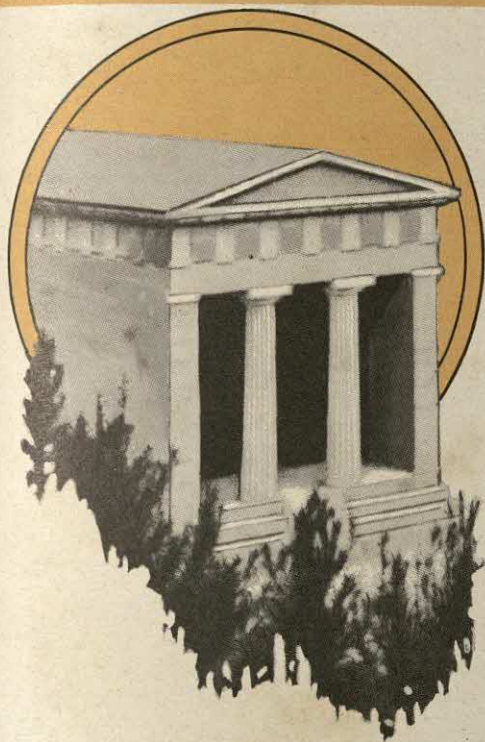
A. H. Verrill




WHEN THE AZTECS KILLED THEIR EMPEROR

During the Spanish invasion of Mexico, Montezuma was seized by Cortez and forced to recognize the authority of Spain. The proud Aztecs, over whom Montezuma ruled, would not submit and rose in angry revolt. When Montezuma attempted to quiet them, they refused to listen, and, as this picture shows, they shot their arrows and hurled stones at him. Wounded in mind and body, Montezuma refused all aid from the Spaniards, tore off his bandages, and died.





B. The second letter of our alphabet was originally the crude picture of a house open on one side, like this . It was the sign that the Phoenicians adopted from the alphabet of a Semitic people who were familiar with the Egyptian picture writing.

The Phoenicians were an energetic commercial people. They planted colonies all along the shores of the Mediterranean Sea, and about 1200 B. C. they were carrying on a brisk trade with the Greeks. Records of their transactions were written in alphabetic signs, and these were adopted by the Greeks themselves, about 1000 B. C. The Phoenicians called the second letter *beth*, meaning house, and this became the *beta* of the Greek alphabet.

In making this letter, the Greeks softened the straight lines of the Phoenician *B*, and wrote it from left to right, as we do. It next became a letter of the Latin alphabet, and so passed on down to modern alphabets.

BABBITT, *bab'it*, **METAL**. Isaac Babbitt (1799-1862), a goldsmith of Boston, invented the "recipe" or formula for the mixture of metals which is given his name. Babbitt metal is a soft alloy made of tin, copper, and antimony, and is used to line the supports or bearings of such mechanical parts as cranks and axles, to reduce friction. It consists of hard particles of antimony, embedded in a somewhat softer mass of the alloy. The revolving shaft comes in contact only with the hard particles, and the bearings do not become heated so easily. Rebabbiting is the process of replacing Babbitt metal.

BA'BEL, **TOWER OF**. According to the eleventh chapter of *Genesis*, Babel was a great tower located on the plain of Shinar in Mesopotamia. Its construction was undertaken by the descendants of Noah following the great deluge. Displeased with their attempt to erect a tower to heaven, Jehovah caused the speech of the

builders to be confounded. Each spoke a different language and no one could understand another. "Babel" has thus come to mean any confusion of sound, although, literally, the word means *Gate of God*. Commonly identified with the Tower of Babel is the great temple of Belus (or Bel), which was one of the chief edifices in the city of Babylon.

BAB-EL-MANDEB, *bahb'el mahn'deb*. Ships plying the waters between the Orient and Europe by way of the Suez Canal must pass through Bab-el-Mandeb, the strait connecting the Red Sea and the Indian Ocean. Since it is the outlet for this great sea traffic, the strait is considered very important to the commercial world. It is formed by the projecting points of Arabia, in Asia, and Ethiopia, in Africa. At its narrowest point the strait is fifteen miles wide. It has two channels. The name, meaning *gate of tears*, refers to the wrecks that occurred there.

BABOON, *bab oon'*. Of all the chattering and noisy creatures we see in the monkey house of the zoo, the baboon is the ugliest and fiercest. The deep-set eyes, flabby, pouchy cheeks, heavy eyebrows, pouting mouth, and long, naked, doglike muzzle give the baboon the appearance of being what it is—ill-tempered and sullen. A baboon is very different from some of its smaller neighbors who are lovable and friendly. It would not make a good pet to have around the house.

The baboon can run very swiftly, for its feet are well proportioned and strong. Yet it cannot stand up very well, since its limbs are nearly all the same length. Most baboons are about the size of a large dog, and have bare, callous patches on their buttocks which are brilliantly colored. Their tails are usually short. Baboons come from Africa, where they congregate in bands in barren, rocky regions, roaming about on all fours. When anyone approaches them, they become fierce and dangerous and start throwing stones and dirt at the intruder. Their diet consists of anything that can be eaten, but principally fruit, roots, eggs, and insects.

The *mandrill* is the largest and ugliest of the baboons. It has a crest of black hair and an orange-yellow beard. Its cheeks have large swellings and are colored with stripes of red and blue. The long nose is tipped with scarlet. A first view of the mandrill is startling indeed, for it looks like an animal out of a story book. Mandrills come from West Africa.

Common baboons inhabit the central and northerly portions of Africa, and are distinguished by their brownish-yellow color. The *chacma*, or *pig-tailed* baboon of South Africa, has long, dark brown, shaggy hair. It is an unwelcome visitor to the farms and gardens of its locality.

Even though we may see nothing attractive about a baboon, the ancient Egyptians used to worship the *hamadryad* of Ethiopia. This type has long hair, which forms a sort of shoulder cape. *Anubis* baboons have olive-gray coats, dark paws, and a

bristling crest at the back of the neck.

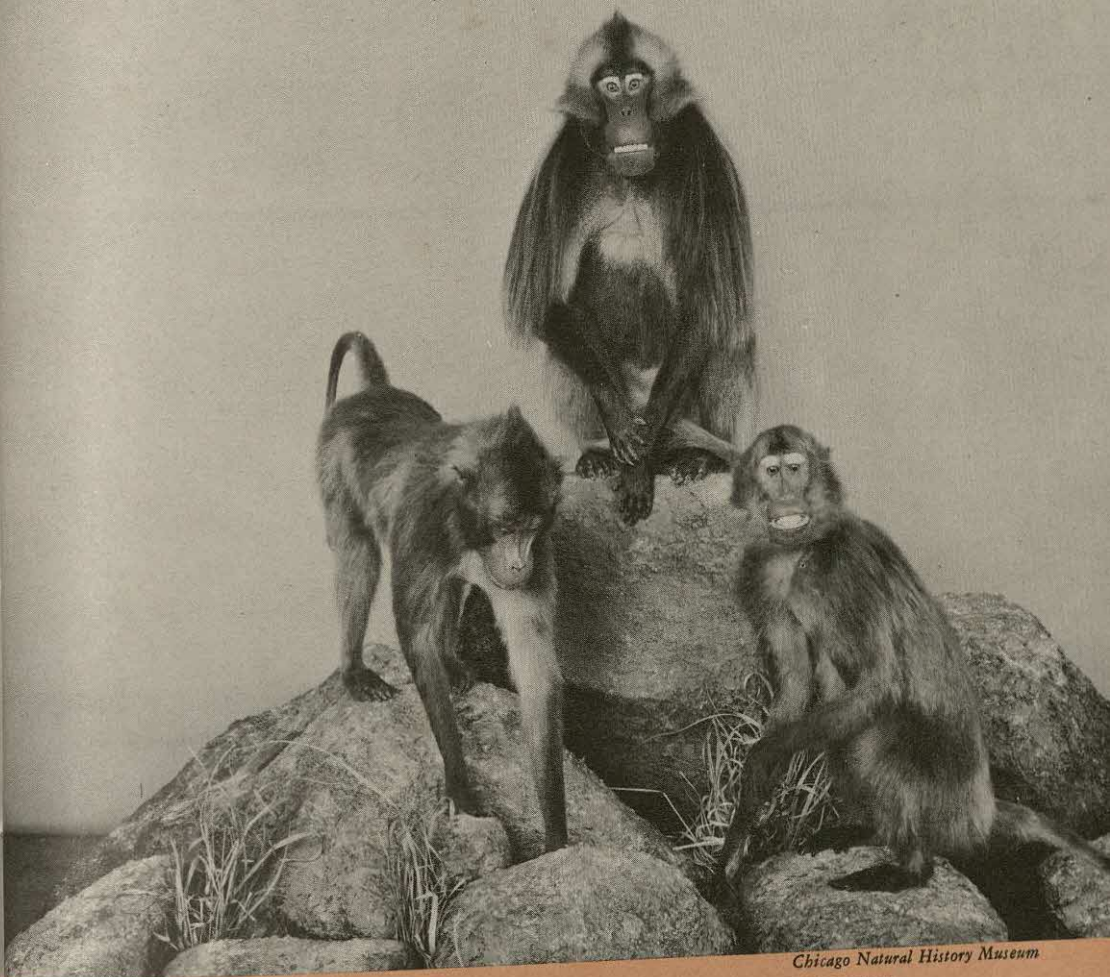
When baboons are in their cages, they often spend their time looking out through the bars and staring at visitors. They seldom seem very active. Other monkeys are much more fun to watch. See **MANDRILL**; **APE**; **MONKEY**.

BABYLON, *bab'i lon*. Today only a memory and a scene of excavations, Babylon was once the mightiest, wealthiest, and most splendid city in the world. There, Nebuchadnezzar built one of the Seven Wonders of the Ancient World, the Hanging Gardens, to please his homesick wife. There, also, was built the Biblical Tower of Babel with its confusion of tongues.

The city existed as long ago as the sixteenth century before Christ, but was destroyed in the year 689 B. C. by Sennacherib, an Assyrian king. A new city was founded by Nabopolassar, a great Babylonian ruler, and his equally great son, Nebuchadnezzar, and it was under them that the great works of art and imposing buildings were constructed.

When Nebuchadnezzar died, the glory of Babylon began to decline, and in 538 B. C., Cyrus the Great, founder of the Persian Empire, conquered the city without a struggle. It then disappeared from world affairs. Modern scholars and scientists have excavated the site of this ancient city. From their work, it appears that Babylon had an area of about twelve square miles and that it was surrounded by strong, thick walls. See **HANGING GARDENS OF BABYLON**; **SEVEN WONDERS OF THE ANCIENT WORLD**.

BABYLONIA, *bab i lo'ni ah*. Flat, cheerless wastes make desolate the land that was once the home of a great civilization. Fields that yielded harvests of wheat and rice are dry and deserted. Ruins of splendid palaces and temples are covered by the silt of the Tigris and Euphrates rivers. This desolation is Babylonia, once the center of the civilized world; today it is an out-of-the-way portion of the kingdom of Iraq.

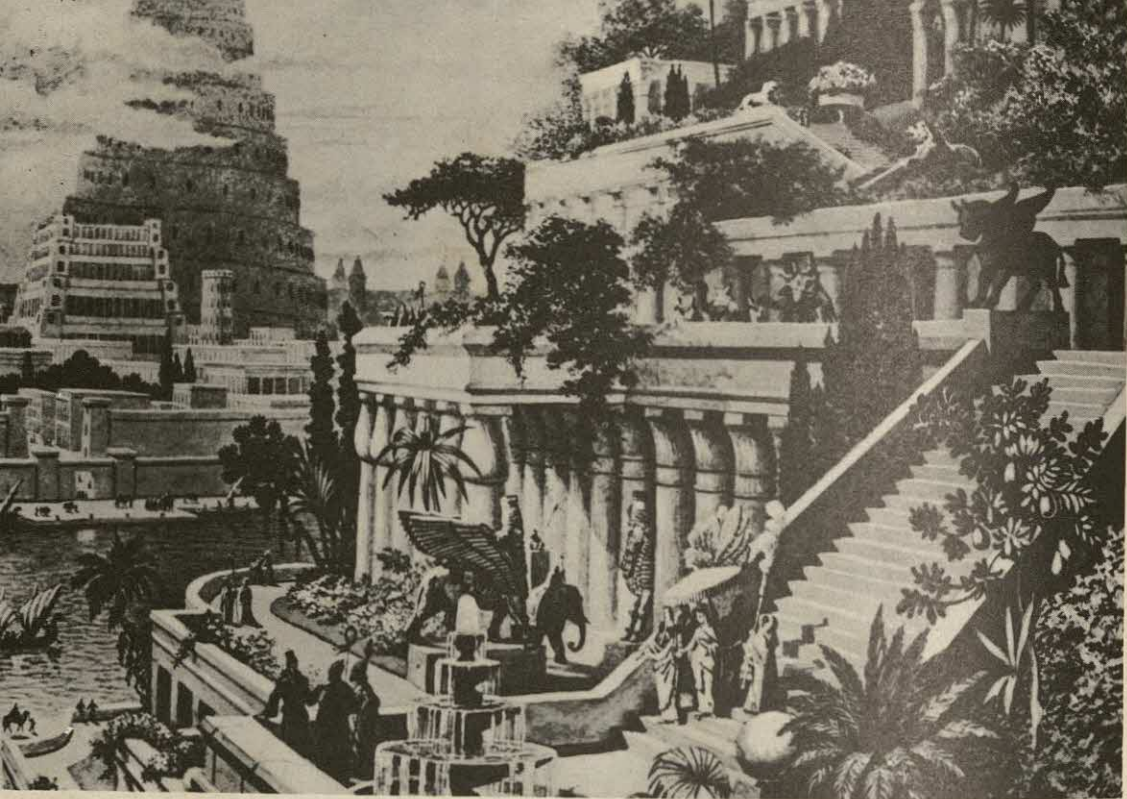


Chicago Natural History Museum

A LIVELY FAMILY AND A LONG-DEAD KINGDOM

Above is a family of gelada baboons, native to Ethiopia in eastern Africa. Below is a map of the ancient kingdom of Babylonia. Today, the Tigris and Euphrates flow together.





THE HANGING GARDENS OF BABYLON

Thousands of workers toiled to make the Hanging Gardens a wonder of the ancient world.

What Excavations Reveal. The modern world knew little of Babylonia until about a century ago; except for the Bible and some Greek writings, it was a forgotten land. Excavations, however, have shown us much about the people who lived in this region from thirty to forty centuries ago; people who created a mighty civilization. We know that the inhabitants of the southern plain between the Tigris and Euphrates rivers built large cities and irrigation canals; that they were fond of literature and art, writing stories and laws on clay tablets and carving innumerable figures on their walls. We know that they were ambitious traders, engaging in business, buying and selling the grain, spices, and rich cloths of the East.

The center of this once great land was the city of Babylon, where Nebuchadnezzar built the famous Hanging Gardens. The Tigris and Euphrates rivers bounded the country on the east and west. To the

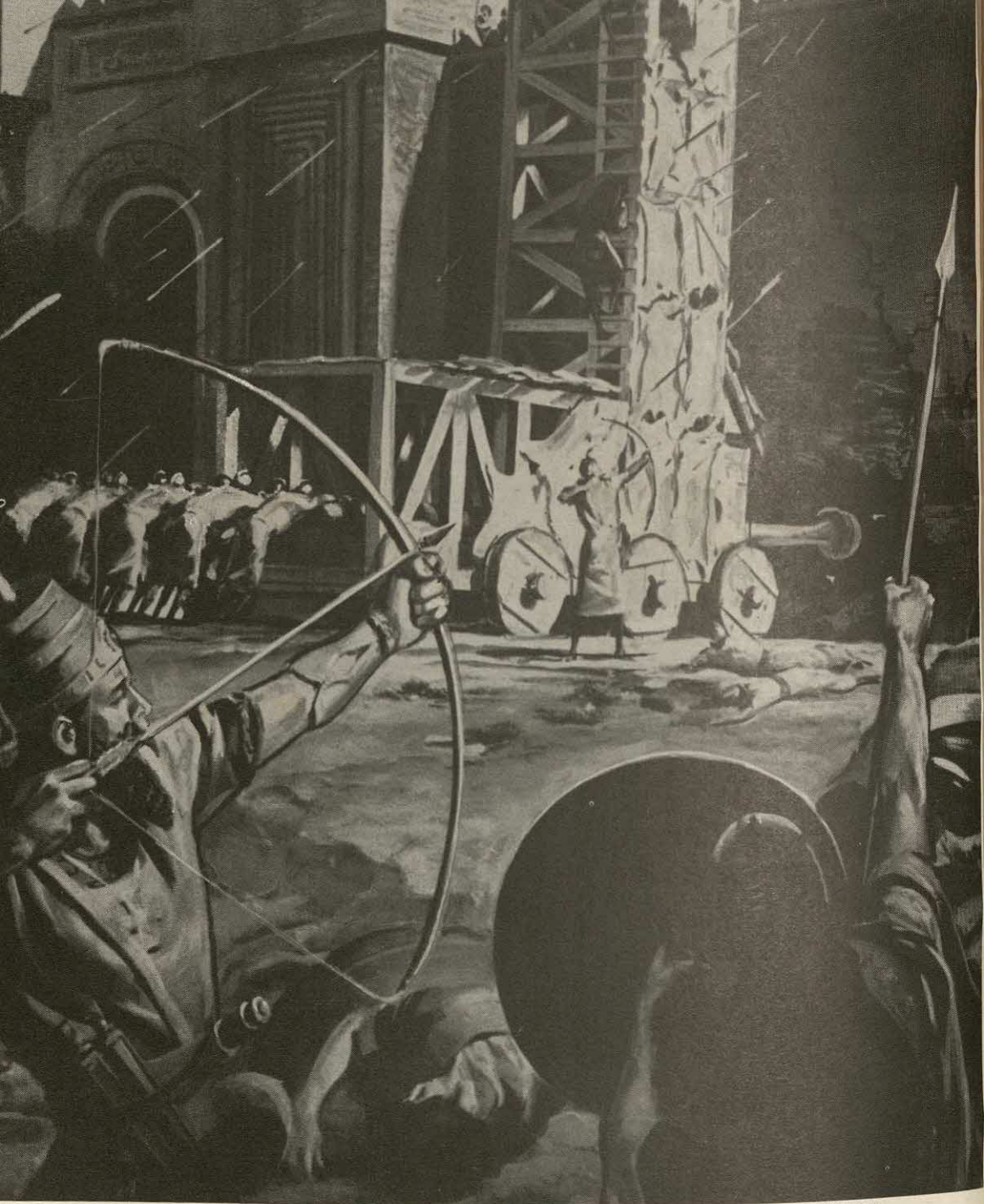
north were the warlike Assyrians, and on the south was the Persian Gulf. The Babylonians divided their land into districts. The northern part was called Akkad, or Accad, and the southern territory was named Shumar, or Shinar. The people were ruled by a king who appointed agents to govern the provinces. These agents dwelt in luxurious palaces, secluded from the people they ruled.

Clay tablets found in the ruins of the cities reveal the varied interests of the Babylonians. They wrote prayers and hymns, and works on science, engineering, farming, and law. Their religion was the worship of several gods, and also of the dead. Because there was little or no stone in the land, clay bricks, baked in the sun, were used in their architecture. The buildings were erected on high platforms, reached by elaborately decorated stairways. Statues, carved basins, and wall decorations show that the Babylonians were highly developed artists.



DANIEL AND KING NEBUCHADNEZZAR

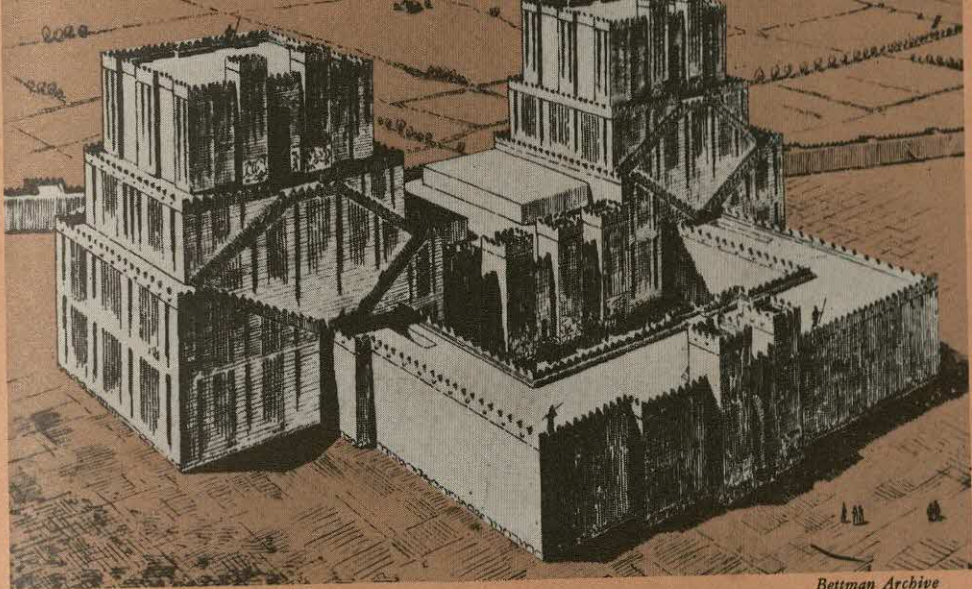
The young Hebrew captive, Daniel, a great prophet of Bible days, explains Nebuchadnezzar's dream to mean that his kingdom of Babylon will last during his life, then fall before another power.



Hughes Tool Company

THE PERSIANS ATTACK BABYLON

Using a huge battering ram to break down the walls of Babylon, the Persians conquered the city and the kingdom, as Daniel had predicted.



Bettman Archive

SKYSCRAPER HOUSE OF WORSHIP IN BABYLONIA

The Babylonian ziggurat was built tall so that worshipers could observe the stars from its top. Astrology was important in Babylonian religion.

History of the Ancient Kingdom.

Long before there was a Babylonia as described in the Bible, there were settlements in the region. These have disappeared and cannot be excavated, although some painted pottery and copper weapons made by these ancient inhabitants have been dug up. The Sumerians were the first people of whom we have definite knowledge in Babylonia. They built cities and canals, and created many works of art. Yet they were unable to hold the country, losing it to the Akkadians, a people very similar to the Hebrews and the Phoenicians.

The first recorded kingdom was set up about 2,100 years before Christ by Hammurabi, in the city of Babylon. Under him, laws were laid down, a system of taxation was begun, women were given the opportunity to engage in business, and such engineering feats as the clearing of the Euphrates River for navigation were accomplished.

Two hundred years later, Babylonia began to colonize Assyria, but the people of that country soon broke away from the rule of their parent nation and warred against the Babylonians. For five centuries after 1782 B. C., Babylonia was ruled by the Kassites, a people from Media.

There were four changes in dynasties, and, after many wars, the Assyrians, under Sargon II, set out to conquer the land. The Babylonians were a peaceful people, very unlike the Assyrians, who lived for power and warfare. Consequently they lost to their rivals in 710 B. C., and Babylonia became a province of Assyria. The conquest was made complete in 689 B. C., when Sargon's son, Sennacherib, destroyed Babylon.

But the tyranny of Assyria was not to last long. The Babylonians rebuilt their city, and, within the next century, Nabopolassar, of Chaldea, aided by the Medes, revolted and led a victorious campaign against the Assyrians. Nabopolassar established a new kingdom in 626 B. C., and under Nebuchadnezzar, his son, who ruled from 604 to 561 B. C., the country became one of the most powerful in the world, conquering Jerusalem, Tyre, and parts of Egypt. It was during his reign that the Jews were taken into captivity, and that many of the great temples and palaces were built.

With the death of Nebuchadnezzar, however, the glory of Babylonia began to decline. Weak and foolish rulers followed him, and, finally, as the wise man

Daniel had prophesied, Babylonia fell to Cyrus the Great of Persia in 538 B. C. Babylonia became a Persian province, then was conquered in turn by Alexander the Great. In spite of its loss of freedom, however, the country remained fairly prosperous. Then came catastrophe. In the thirteenth century the Mongols invaded the land, destroyed the cities and villages, laid waste the fields, and wrecked the canals and works of art, leaving a desert.

In World War I, Baghdad, a city to the north of ancient Babylon, was captured from the Turks by the British, and the kingdom of Iraq (Mesopotamia) was set up, comprising the ancient lands of Assyria and Babylonia. See **BABYLON**; **ASSYRIA**; **ARCHAEOLOGY**; **IRAQ**.

BACCHUS, *bak'kus*. In Roman mythology, Bacchus was the god of wine, corresponding to the Greek Dionysus. Bacchus is described in legends as the deity who taught men to cultivate the grapevine and to make wine by fermenting juice. He was the son of Jupiter and Semele. Feasts and orgies were held in his honor by the Romans, and the carnivals in the wine-producing countries today are handed down from these early Bacchanalia, as the celebrations were called. The Bacchanalia themselves became so corrupt that the Roman Senate abolished them in 187 B. C.

BACH, *bahk*, JOHANN SEBASTIAN (1685-1750). Earliest of the great German composers, Bach in his own day was looked upon only as a matchless organist and harpsichord player. It was not until 100 years after his death that the



JOHANN BACH

world came to recognize him as one of the greatest composers of all time. His writing influenced so many other musicians that he is known as the "master of masters." His family produced more than

fifty musicians; four of his eleven sons were distinguished in their father's art.

At the age of eighteen, Bach was engaged to play in the court at Weimar, and later held an appointment at Leipzig. His fugues are the most perfect ever written. Besides his many compositions for the organ, he wrote scores of studies for the piano, as well as oratorios, masses, and church cantatas.

BACILLUS, *ba sil' us*. Bacteria, the lowest forms of plant life, are divided into three groups, according to their shape. To the rod-shaped bacteria the name bacillus (plural, *bacilli*) is given. See **BACTERIA** AND **BACTERIOLOGY**.

BA'CON. On a frosty morning, when you wake up hungry and refreshed, how delicious is the aroma of bacon frying in the skillet in the kitchen. It alone is enough to make one dress in a hurry and meet the day with a desire to be up and doing. Bacon is one of the most popular meats in the world. Not only is it savory, but it is also nourishing. Because it produces heat and energy, bacon is particularly valuable as a cold-weather food. It comes from the sides and back of the hog, and is salted and smoked in the packing house. No grease is needed to fry it, but its grease can be used to fry any number of other edibles.

BACON, FRANCIS (1561-1626). Before the time of this English thinker, writer, and jurist, logic was based on the methods of Aristotle. The famous Greek philosopher taught that one could arrive at a particular fact by making use of a general truth. This method is *deduction*, or reasoning from the abstract to the concrete. Francis Bacon introduced the method called *induction*; he showed that one can reach a general truth by the study of concrete cases.

Bacon was also one of the most famous essayists in English literature. His *Essays*, numbering fifty-eight and treating a variety of subjects, are models that can be followed in writing compositions that are concise, full of meaning, and well ar-



LORD FRANCIS BACON

ranged. Bacon lived at the same time as Shakespeare, and some authorities believe that he was the real author of the Shakespearean plays and sonnets. Of course, this theory has never been proved or generally accepted.

Bacon was but a small boy when he was first presented at the court of the great Queen Elizabeth of England. "How old are you?" the queen asked young Francis. Quick and courtly was his reply: "Two years younger than your majesty's happy reign!" He became a lawyer at twenty-one, two years later was a member of Parliament, and rose through high legal offices to be made Lord High Chancellor in 1618. He was afterward made a viscount, becoming Lord Bacon. Yet, with all his learning, he fell into disgrace by accepting bribes while he was a judge, and was fined \$200,000 and sentenced to imprisonment in the Tower of London.

Pope, the poet, called Bacon the "wisest, brightest, meanest of mankind." Bacon's penalty was lifted and his career resumed, and when he died it was of illness contracted in an experiment with snow, the success of which has led to the modern cold-storage systems.

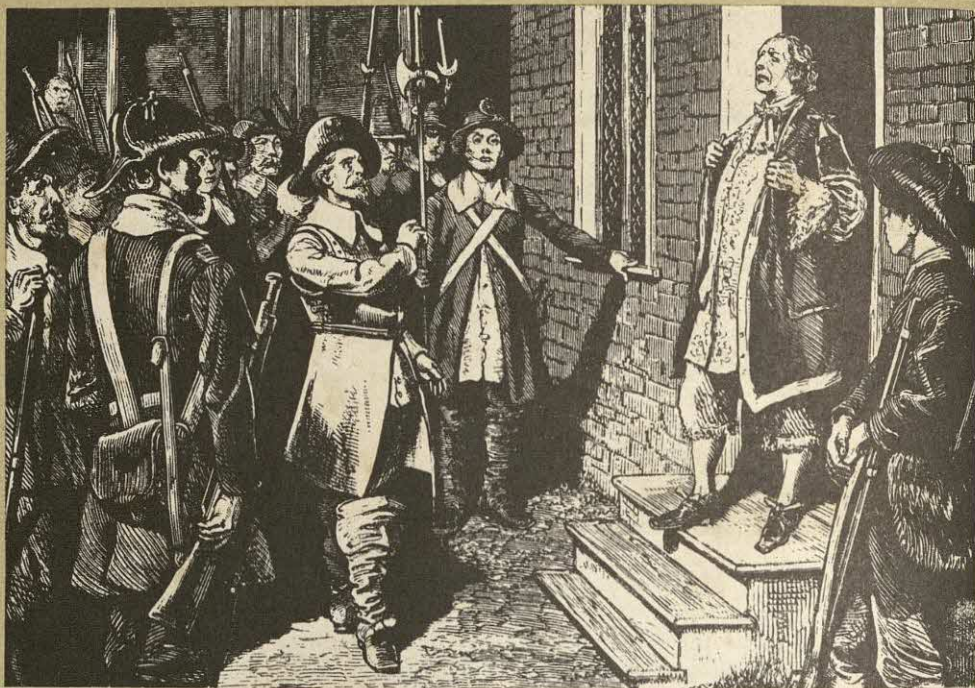
BACON, ROGER (about 1214-1294). Centuries ago Roger Bacon, an English monk, predicted that some day there would be such things as automobiles, airplanes, steamships, and machines to lift great weights. Of course, he did not use the names we give to these inventions today.

To the monks who were his superiors, the things Bacon studied and wrote about seemed like "black art" or magic; so for many years he was kept in prison. But Bacon was really one of the most profound and original thinkers of his day and did much to stimulate scientific methods. He studied at the universities of Oxford and Paris and could read Greek, Latin, Hebrew, and Arabic. He experimented with gunpowder and telescopes and even believed that the world is round. His most important writing is the *Opus Majus*, in which he discussed language, optics, experimental science, and the relation of philosophy to religion.

BACON'S REBELLION. One hundred years before the American Revolution, another famous rebellion occurred. Complaining of unequal taxation, unpopular navigation laws, and the refusal of Governor William Berkeley to take a stand against the Indians, Virginia colonists in 1676 rose against the governor. Nathaniel Bacon, their leader, had been refused a commission by the governor to fight the Indians, and so he took it upon himself to organize an expedition against the tribes. It was victorious, and, on his return, Bacon defied the governor's power.

He escaped the penalty of rebellion by dying suddenly of a fever, but several of his fellow leaders were put to death by Governor Berkeley. Bacon was an English-born lawyer, distant relative of Lord Bacon, the famous essayist and philosophical writer.

BACTERIA AND BACTERIOLOGY, *bak te ri ol' o ji*. When the school children of France are asked to name the greatest man their country has ever known, they say "Louis Pasteur." Generals, kings, and emperors, statesmen,



FORECAST OF AMERICAN REVOLUTION—BACON'S REBELLION

Virginia colonists resent the English governor's refusal of aid in repulsing Indian raiders.

poets, and novelists, philosophers, mathematicians, and astronomers, inventors and leaders in industry, all the types of men that are heroes to boys and girls in other lands are second, in France, to a man who spent his life in a laboratory. And if scientists all over the world were asked which science had done the most and can do the most for human life, it is not unlikely that most of them would name the science which Pasteur studied, *bacteriology*.

A century ago this science was just beginning to evolve. Today it enters into our lives in myriad ways. Bacteria, those very tiny one-celled plants, some of which we can see with a microscope, and some of which we cannot see at all, are everywhere about us. Some of them can be very troublesome to us and some can be very valuable. But the more we know about them the less trouble and the more help they give us.

What Bacteria Do. As chemical agents bacteria are responsible for many types of

chemical change. They cause decay and fermentation of all sorts. In soils they decompose vegetable matter, thus enriching the soil, and help to make available the nitrogen and the mineral constituents of plant food. A number of species of bacteria are able to combine atmospheric nitrogen with other chemical elements so that it stays in the soil.

In the dairy industry, lactic-acid bacteria and others are extremely important, because they make sour milk and buttermilk and cause the ripening of cheese. In the preservation of silage and of human foods, in breadmaking, in the fermentation industries, in the tanning of leather, and in the retting of flax and hemp, bacteria play a more or less prominent rôle.

As disease carriers, bacteria are of outstanding significance, being the active agents in such human diseases as tuberculosis, bubonic plague, typhus, typhoid, diphtheria, and pneumonia; in hog cholera, glanders, tuberculosis, and anthrax, of

animals; and in various blights and wilts in plants.

The Smallness of Bacteria. Tiny cells that were still invisible when magnified 3,000 times can now be seen and studied by scientists using the powerful electron microscope. This revolutionary instrument, which uses short electron waves and a photographic plate, can magnify bacteria, even cancer cells, up to 200,000 times. Many of the well-known species are larger and average about one micron (one millionth of a meter, or about 1/25,000 inch) in length. When 25,000 of these are placed end to end in a row, they will cover the space of one inch. There are also giants among bacteria that attain the length of thirty to forty microns. Among the so-called higher bacteria a still larger size is attained.

What Bacteria Are Like. Bacteria vary as to shape, and on this basis are divided into three classes. Some are spherical (*cocci* or *micrococci*), some are rod-shaped (*bacilli*), and some look like bent rods or corkscrews (*spirilla*). The singular forms for these names are *coccus*, *bacillus*, *spirillum*. Under some conditions the cells become irregular in shape and size and are then designated as *involution* forms. These are not uncommon among the bacteria which help clover, beans, and other legumes to get nitrogen, or among the vinegar bacteria.

When observed under the microscope, some bacteria are seen to be able to move about slowly or rapidly and are then said to be *motile*. When not able to move about, they are called *non-motile*. Bacteria is the scientific name of these plants, but in medical practice this term is used interchangeably with *germ*.

How Bacteria Increase. The organisms multiply by dividing into two parts. In the case of the rod-shaped bacteria, it is easy to observe the constriction in the middle and the division, very much as if a cigarette were broken in two. Under favorable conditions this occurs in twenty to thirty minutes. A new generation is

thus born and the process may go on indefinitely. Theoretically, a single cell, dividing only once an hour, would become the progenitor of 281,500,000,000,000 cells in forty-eight hours. Adverse influences soon make themselves felt, however, and growth is checked.

By learning what conditions are favorable to bacteria of each type and what conditions check them most quickly, we are able to make useful bacteria more useful and harmful ones less harmful. Some species of bacteria form types of cells more resistant to drying, heat, or chemicals. These cells are called *spores*, and are a means of resistance to unfavorable conditions rather than of multiplication.

Conditions Helping and Hindering Bacteria. Ordinary boiling will kill all vegetable cells, but not spores. When boiling is continued for sixteen hours or more, the spores also are destroyed. Steam under pressure in a gas-tight vessel at a temperature of 257° F. will kill all cells, including spores, in fifteen minutes. Low temperatures affect bacteria much less than do high temperatures. The organisms of tuberculosis, typhoid, and diphtheria, likely to find their way into milk or other food, do not form spores. Therefore pasteurization, or heating at 140° to 195° F., from a few seconds to thirty minutes, according to the method used, will ward off infection.

Drying is destructive to the vegetative or reproductive cells of bacteria. Where these are protected by a covering of foreign material, there may be a considerable degree of resistance, as, for instance, in soil, vegetable matter, and saliva. The spores of bacteria sometimes survive drying for months or even years. Direct sunlight is also injurious to bacteria, particularly the blue and violet rays of the sun's spectrum. Other destructive agents include electric light, salts of mercury, carbolic acid and its derivatives, mineral acids, and alkalies like caustic potash and soda.

These agents are called germicides ("germ killers") and disinfectants ("infect-

tion destroyers"). Antiseptics differ from germicides in that they will prevent the growth of bacteria, but not necessarily kill them.

Bacteriology and Health. Bacteria are everywhere about us, in the air, the earth, and the water. We breathe, eat, and drink millions upon millions of them. Most of them are harmless, but some are trouble makers. Scientists have found that there are more bacteria in human habitations than outdoors, more in the city than in the country, more in the lowlands than in cold climates, and more on land than on sea. This may explain, in part, why, with similar attention to health standards, people who live in the country are less frequently diseased than city people, but another reason is that a vigorous outdoor life often gives greater ability to resist germs.

But country people sometimes permit themselves to be endangered where city people are protected. In such cases they need to know enough of bacteriology to remember that a well within 100 feet of a cesspool may become polluted with disease germs, that germs are carried into open cuts and wounds by dirt, that refuse and swill carelessly thrown into back yards breed bacteria, that it is just as important to quarantine contagious diseases in the country as in the city.

Bacteriology for the Housewife. Bacteria are both the friends and the enemies of the woman in charge of a household. It is to her interest to know the conditions favorable and unfavorable to the growth of bacteria in general, for the fewer bacteria of all kinds there are in her home, the less she will have to contend with soured milk, spoiled food, and sickness. She may often be helped, too, by knowing the reasons for the different methods of food preservation—canning, preserving, pickling, smoking, salting, etc.—and the effective limits of each. Occasionally, she may make use of bacteria when she wants sour milk, sour bread, specially ripened cheeses, or homemade vinegar, sauerkraut, dill pickles, or kumiss. As the household

engineer she may make still greater use of bacteria and bacteriology if she has her house equipped with septic plumbing.

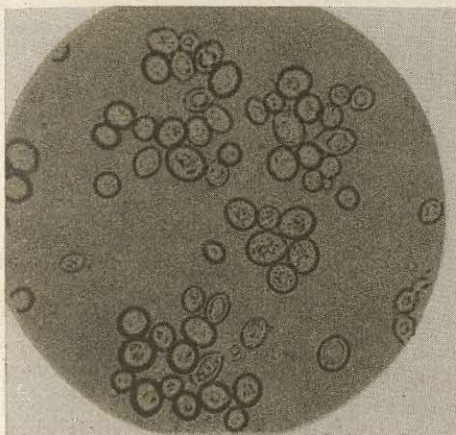
Bacteriology for the Manufacturer.

The manufacturer of dairy products needs to use bacteriology even more than the dairyman. The creamery operator uses certain bacteria constructively to ripen cheese and cream for butter; others he must keep out at all costs if he would avoid rancid butter and faulty cheese. The more he learns about these bacteria, the better and cheaper he can make his products. The maker of condensed milk, powdered milk, or evaporated milk must know the best and most economical methods for preventing bacterial action in his product.

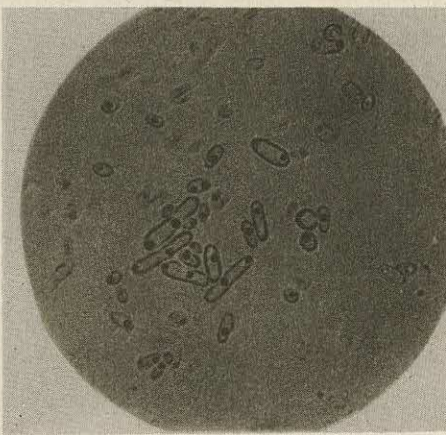
Similarly, manufacturers in other lines, especially those based on agriculture, use some bacteria and fight others. The canner of vegetables, fruit, or meat; the meat packer; the baker; the retter of flax; the tanner of leather; these and many others find that a knowledge of bacteriology helps them to conduct their businesses so as to give better satisfaction to their customers with less expense.

Bacteria and the Soil. The countless bacteria in our soils sometimes work for us, sometimes against us, and the aim of bacteriological investigators is to learn how to make them always help instead of hinder. For instance, if bacteria of one kind thrive in humus, they will cause its rapid disappearance. If another kind dominates, the humus will decay slowly. Therefore bacteriologists strive to learn which variety should be encouraged in each type and condition of soil, for while rapid decay is desirable in some soils, in others it will cause waste; and while slow decay is in some cases an advantage, in others it will cause souring.

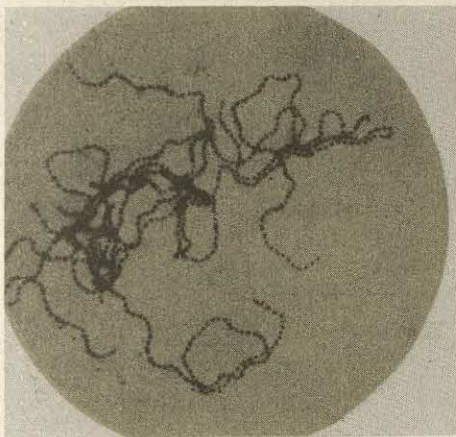
Again, some varieties of bacteria are believed to be less wasteful of the nitrogen resources of the soil than others, and if bacteriologists can learn which are the most efficient, and devise means of supplying them to farmers and encouraging their growth, great economies will result.



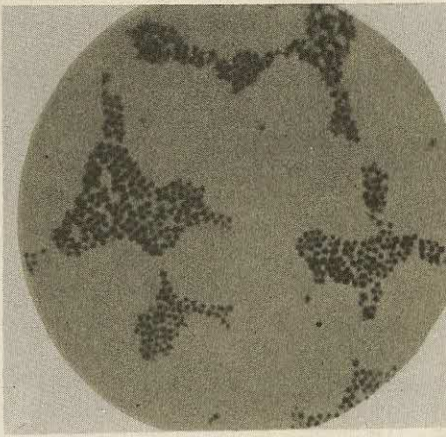
Under a microscope, the normal process of fermentation looks like this.



And the organisms which produce what is termed abnormal fermentation look like this.



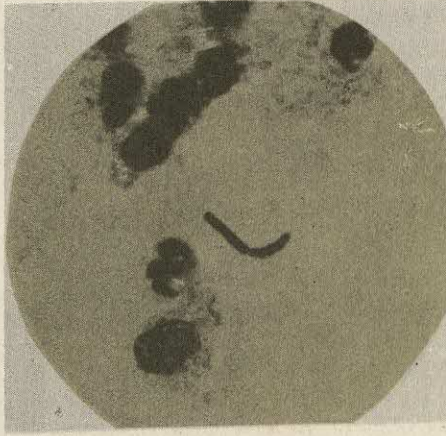
This is the peculiar chain formation assumed by a very virulent Streptococcus.



Staphylococcus, showing the characteristic arrangement of this organism in clumps.



These highly magnified twining links are the germs of anthrax.



The bacillus which causes tuberculosis (center) frequently takes this strange "V" shape.



E. P. Haddon, Fish and Wildlife Service

THE BADGER HAS A SWEET TOOTH

Because it has a thick coat of hair, the badger can rob the bees of their honey without being harmed by their sting.

BA'DEN-POWELL, ROBERT STEPHENSON SMYTH, First Baron (1857-1940). A distinguished British soldier, Baden-Powell was the founder of the Boy Scouts, an organization active in most of the civilized countries of the world. In 1910, two years after the Boy Scouts were organized, he and his sister, Miss Agnes Baden-Powell, founded the Girl Guides, which is the pattern for the American Girl Scouts.

During most of his life Sir Robert was a military man. At the age of nineteen he entered the army and saw his first service in India. Later he fought in Afghanistan and in the Boer War in South Africa. After his famous defense of 217 days in the siege of Mafeking, he was made a major general; later he was raised to the rank of lieutenant general. He was knighted in 1909 and honored with a baronetcy in 1922. In 1929 King George V raised him to the peerage as First Baron Baden-Powell of Gilwell. See BOY SCOUTS OF AMERICA; GIRL SCOUTS.

BADGER, *bad'ur*. Probably the badger resents the meaning that his name has come to have, for it is a reminder of the cruel sport of badgering. Men would put a captured badger into a barrel and set dogs to drag it out. If the dogs succeeded, the badger would be thrust back into the barrel to fight off the dogs again. This barbarous "badger baiting" gave the word *badgering* its meaning of worrying or teasing.

The badger, found in the north of America, Europe, and Asia, is a squat little animal the size of a dog, but with short legs, tough hide, and long, coarse hair. It is a distant cousin of the bear and the weasel. A lazy, sleepy fellow, the badger burrows into the ground by day and feeds on vegetables and small animals at night. Its hair is sometimes used to make artists' paintbrushes. Wisconsin became known as "the Badger State" because its lead miners in early days lived in rude dugouts like badgers.

BAGHDAD, *bag'dahd*. Famous as the setting for the *Arabian Nights* tales, Baghdad was founded in 762 by the Caliph Al Mansur, and became for 500 years thereafter the center of Moslem civilization and culture. Built on both sides of the Tigris River, in Mesopotamia, the splendid city occupied a site not far from the ruins of old Babylon. Endless caravans from east and west made Baghdad the central market for trade between Europe and Asia. With the rise of Turkish power in Asia Minor, however, Baghdad lost its position of dominance and was all but forgotten by the world until the great powers began competing for influence in Asia.

In 1903 the city became the terminal for the contemplated Berlin-Baghdad Railway, which was over half completed at the outbreak of World War I in 1914. During the war the British conquered Mesopotamia and entered Baghdad in 1917. The entire area was given to England as a mandate in 1920. In 1932, however, Baghdad became the capital of the new kingdom of Iraq.

In the decade following the war, Baghdad more than doubled in population and reached about 500,000. The city is being slowly modernized and is the site of a new airport that serves as a terminal for four great European air systems to the Far East. Modern hotels and hospitals have helped to modernize the appearance of the new portion of the city. See **IRAQ**.

BAGPIPE. Shrill and stirring is the music of the bagpipe, that ancient wind instrument which calls to our minds the kilted Scottish Highlanders marching to its tunes. Today, it is regarded as the national instrument of Scotland, yet there were bagpipe players among the ancient Greeks and there are pipers still in Italy and Poland, France and Ireland. The music is produced from four pipes through which air is forced from a leather bag by the pressure of an elbow. Only one of these pipes, called the chanter, plays the melody; the other three, called drones, sound a weird monotone.

BAHAMA, *ba ha'ma*, **ISLANDS**. The first land sighted in the New World by Columbus is believed to have been that small group of islands now called the Bahamas. They consist of about 3,000 islands and reefs located in the Atlantic Ocean northeast of Cuba and southeast of Florida. Only twenty of these islands are of any size or importance. There has long been a dispute concerning which island Columbus landed upon. He named the island San Salvador, and it has been variously identified as Cat Island, Great Turk, Watling's, and others. Watling's, however, is now believed to have been the place on which Columbus and his mariners first set foot, on disembarking.

The population of the entire group is about 84,000. The largest of the islands is Great Bahama, but Nassau, the capital and largest city, is situated in New Providence.

Fruits are the chief product, and pineapples form the principal export. Cotton, sugar, maize, and ground nuts are also raised. The surface of some of the islands is nearly covered with sisal, from which rope fiber is obtained.

The islands are a favorite resort for people suffering from lung diseases. They were settled by the British at the close of the seventeenth century, and are now under the rule of a British governor.

BAIKAL, *bi kahl'*. Deepest fresh-water lake in the world and the largest one in Asia, Lake Baikal lies in a basin between the mountains of Southern Siberia. During the bleak Siberian winter, ice freezes three feet thick on this lake, and it becomes a highway for traffic. Trucks can be driven over the spot where the lake is more than a mile deep—5,400 feet. Along its southern shore runs the Trans-Siberian Railway. Baikal is 386 miles long and fifty miles across at its widest point. Within thirty-five years after the invention of the steamship, a crude steamer was navigating this remote lake.

BAKING POWDER. Have you ever wondered, on baking day, what magic word was said to make that lump of



SAVAGE RESISTANCE DELAYS BALBOA'S SEARCH FOR THE PACIFIC

In quest of a legendary sea, Balboa and his men were rewarded in 1513 when they sighted the great western ocean and claimed its shores and waters for the crown of Spain.

dough which went into the oven soggy and thin come out a light, fluffy cake or airy white biscuits? The magic was baking powder. It is made of soda, starch, and a substance such as cream of tartar, monocalcium phosphate, or sodium aluminum sulfate. Starch keeps this substance and soda from "fighting" until the baking powder is wet. Then a chemical action sets free carbonic-acid gas, which passes through the dough and makes it light. The dough "rises" because it is full of the tiny gas bubbles thus released.

BALANCE OF TRADE. At the end of every year, each nation adds up the sales it has made to other nations and the cost of goods it has bought from other lands. The difference between these two items is called the balance of trade. If its sales, or exports, are worth more than its purchases, or imports, the trade balance is generally regarded as favorable, for the nation has more money coming in than going out. This is not always true, however, for other factors must be considered, such as investments abroad and international movements of stocks and bonds.

BALBOA, *bal bo'a*, VASCO NUÑEZ DE (about 1475-1517). For twenty-five days the band of white men and Indians under the Spanish explorer and adventurer, Balboa, struggled through the steaming jungles and mountains of the Isthmus of Panama. They were searching for a new and vast sea, which, so the Indians said, lay west of the mountains. The white men had never seen any trace of such a body of water, and some had begun to believe that the expedition was all in vain. Then, on September 25, 1513, Balboa and his men reached the peak of a high mountain and saw a great ocean off in the distance. Blue and quiet, the waters stretched out before them with no land in the distance to show where they ended. The tale of the Indians was true.

Four days later, Balboa reached the shore and, with his upraised sword, claimed, for Spain, the sea and all the shores it washed. Little did he know that this new sea was the largest body of water in the world, the Pacific Ocean, or that its waters washed thousands and thousands of miles of shore that no white man had

ever seen. The ocean was not named Pacific by its discoverer, but by Magellan.

Balboa was overjoyed at his discovery, knowing that it would find favor in the eyes of his king. For jealous men had gone back to Spain to have him removed as governor of the colony of Darien, in Eastern Panama, and Balboa felt that when King Ferdinand had heard of the new sea, he would not listen to these men. With this hope, he hastened back to Darien and sent to Spain word of his discovery.

As Balboa had hoped, the king was pleased, and rewarded him with the position of governor of Panama. But the king failed to halt a man by the name of Davila, who had gone to Darien to become governor there. Davila quarreled with Balboa and plotted for his overthrow. Then, in 1517, after tricking the great explorer into returning from an expedition, he threw him into jail and ordered him executed. Efforts to bring about peace between the two men failed, and in that same year Balboa was executed in the public square of Acla.

Although the world honors Balboa for his momentous discovery and knows the circumstances of his tragic death, little is known of his early life. He was born in Spain about 1475 and sailed to America in 1501, settling in Santo Domingo. He is said to have escaped from his creditors in 1510 by hiding in a barrel which was shipped with an expedition to Darien.

BALDER, *bawl'dur*. God of the sun and of summer brightness was Balder, son of Odin and Frigga in the Norse myths. His was a charmed life. Nothing could harm him, and so it was a favorite sport of the gods to hurl at him their deadliest weapons and to watch them fall harmless at his side. Balder's mother had once obtained a promise from all things in the world that they would not injure her son. But she forgot to exact a promise from a spray of mistletoe growing on a big oak tree.

Balder was loved by all the gods save

one—wicked Loki, who hated him for his beauty and goodness. Loki fashioned a dart from the mistletoe and put it into the hand of a blind god, Hodur, telling him where to throw it. The dart struck and killed Balder. This story is beautifully told in Matthew Arnold's poem, *Balder Dead*.

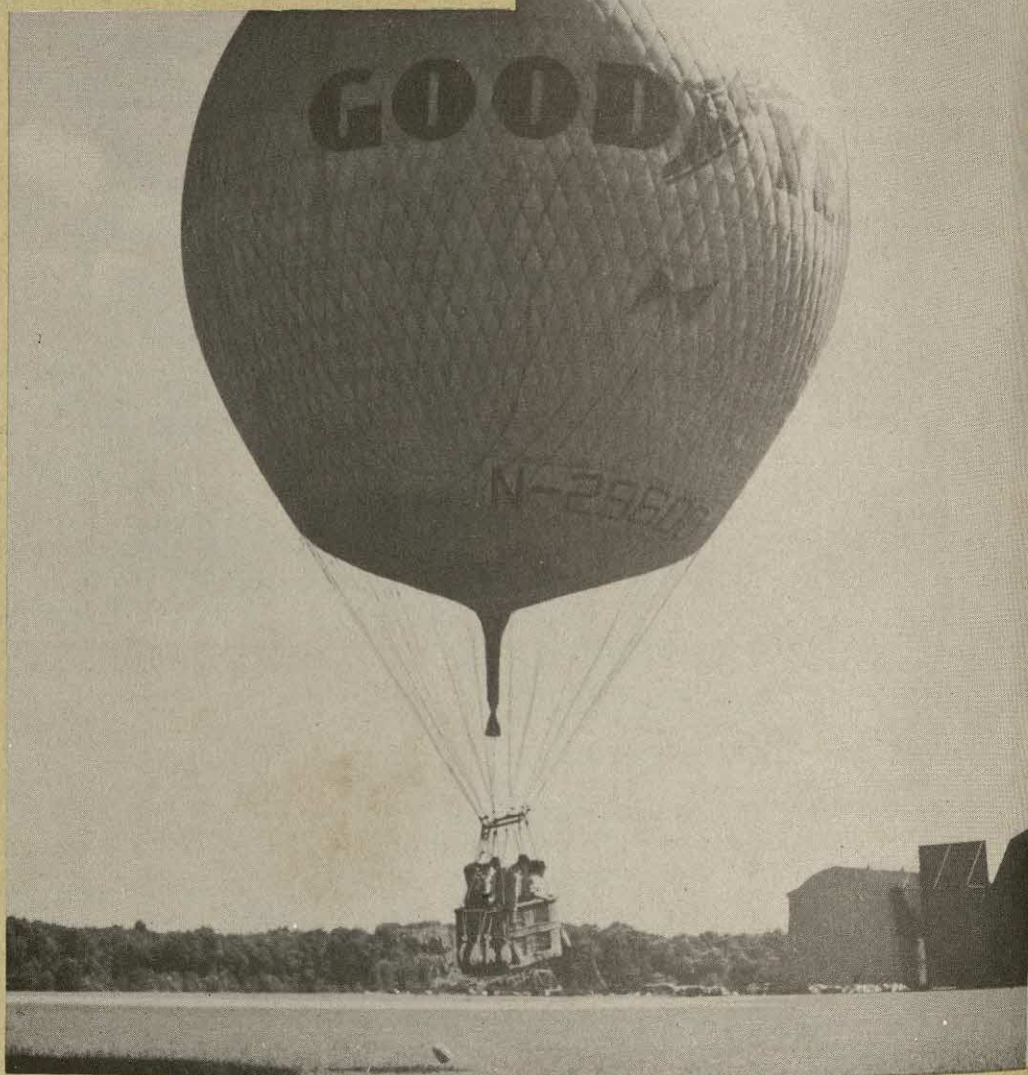
BAL'LAD. Among all literary peoples, the earliest form of poetry has been the story-poem, or ballad. Ballads took form before they were written down, and were passed from father to son. Thus the words often were changed from one generation to the next. The feelings that are common to humanity, rather than individual emotions, inspired these ballads. They told of love, war, death, or some primitive fear. Always they remained simple stories, not expressions of personal feeling.

Every nation of Europe has its own collection of ballads and folk songs of dateless or folk origin. Spanish literature is especially rich in them, and the Serbians are still producing them. The folk songs of ancient Germany are ballads in form. Out of these ballads arose the legendary epic upon which Wagner based his great operas—*Die Walküre*, *Siegfried*, and others of that cycle.

In 1765 the first serious effort to collect and study ballads was made in the publication of Percy's *Reliques* in England. Interest was aroused in other European countries, each nation collecting and writing down its own folk songs. In the British collection are such well-known favorites as *Sir Patrick Spens* and *The Ballad of Chevy Chase*.

The collecting and printing of all the ballads of antiquity brought about a great poetic revival in the eighteenth and nineteenth centuries. Ballads became less formal, more spontaneous. Many of the later poems are imitations of old ballads, examples being Coleridge's *Ancient Mariner*, Cowper's *John Gilpin's Ride*, and Campbell's *Lord Ullin's Daughter*. Longfellow's *Wreck of the Hesperus* is a ballad familiar to American school children.

SAILING THE SKIES... THE BALLOON



Goodyear Tire & Rubber Co.

Sand bags dropped to earth help the balloon ascend by lightening its load. When it is time to descend, gas is allowed to escape to pull the balloon to earth.

BALLOON'. All Paris was astonished when Stephen and Joseph Montgolfier, sons of a local paper maker, sent their thirty-five-foot balloon sailing over the city in the summer of 1783. The gaily decorated bag soared to a height of several thousand feet and traveled more than a mile before it landed.

While people still discussed this earliest of practical balloon flights, the Montgolfier

brothers sent up a balloon carrying a "crew" of a sheep, a rooster, and a duck. When these barnyard aeronauts came down safely, more ambitious plans were laid—for a flight on which a human being would actually be carried through the skies. Greatly daring, a young man named de Rozier volunteered for the attempt and, before the year ended, really flew over the heads of a breathless Paris crowd

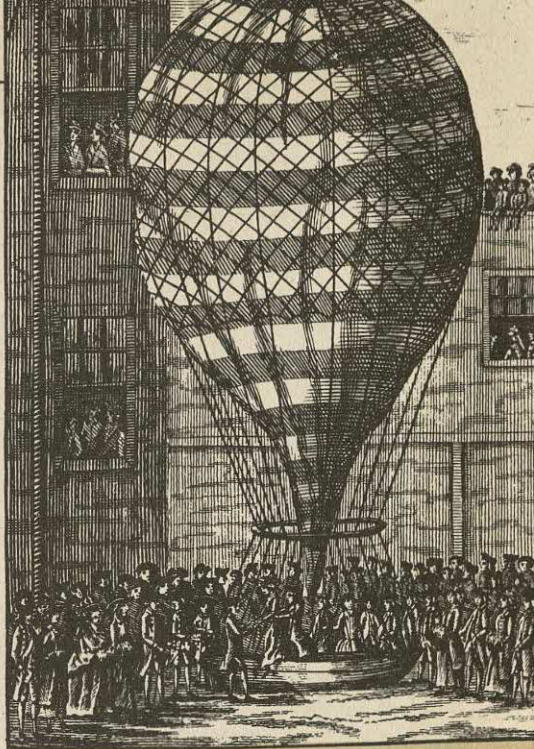
and descended to the earth unharmed.

From that time on, air travel took strong hold of public imagination. A number of progressive men hastened the development of the free, man-carrying balloon, among them Charles and Robert, Blanchard and Jeffries, and Lunardi. The original Montgolfier model was a bag



made of paper and linen, filled with hot air and smoke by a fire built beneath an opening at the bottom. Wet straw and greasy materials were used for the fire at first because it was believed that the dense smoke thus created was the source of lifting power. Later, the experimenters found that they could make a balloon stay up longer by keeping a fire under it in flight, the fire being kindled in an iron basket, or grating, slung beneath the bag.

Hot air rises because it is lighter than cold air. Enclosed in a bag of sufficient cubic capacity, hot air develops enough lift to carry the bag and attached load up with it. When the air cools, it loses its



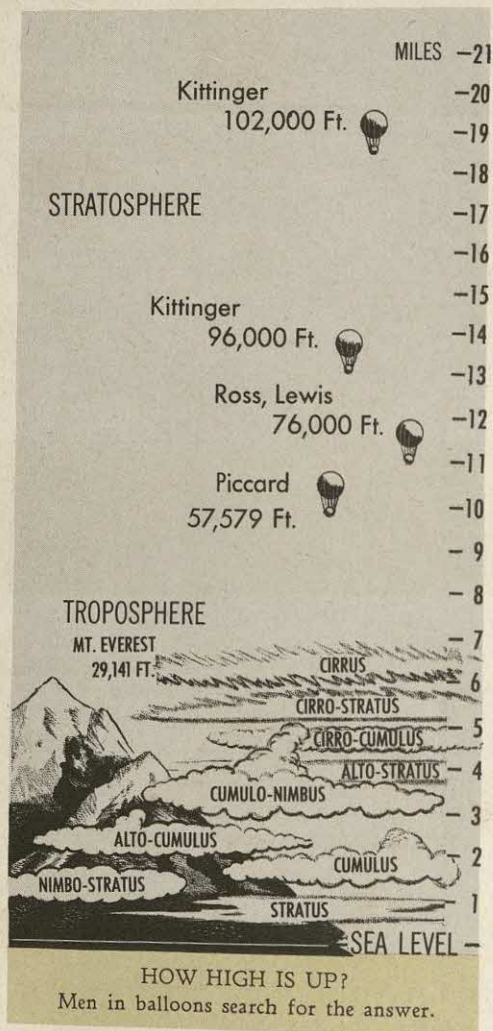
U.S. National Museum

EARLY "INNER SPACE" TRAVEL

The first balloon flights were short in time and in the distance traveled. Practical ballooning was first demonstrated in France in 1783 by the craft of the Montgolfier brothers (left). Later in the same year Francesco Zambecari, an Italian count who happened to be in London, launched an oil-silk balloon—the first to ascend in England.

"lift," relative to the surrounding atmosphere, and the balloon will descend. Even though hot air is cheap and easily provided, the early balloonists soon deserted it for other lighter-than-air gases which lasted longer and were safer. It was risky and impractical to venture into the air with only a live fire and an inflammable bag between the aeronaut and disaster.

Cavendish, an English scientist, had discovered in 1766 that hydrogen is lighter than air and, by the 1800's, distance balloon flights were made with this gas as the lifting agent. Coal gas also was used, as it gave fair lift and was cheap to produce. The art of ballooning enjoyed an immense vogue and spread to many parts of the world. With inflation made convenient and means of balloon navigation im-



A valve for releasing small quantities of gas when descending is placed at the top of the bag, inside, and controlled from the basket by a cord which passes down through the bag and out the neck. A rip panel and rip cord provide for the quick opening of a large gap in the bag to release large quantities of gas in emergencies. The basket is fitted for needed equipment, such as ballast sandbags, pigeon crate, camera, navigation instruments, radio, grappling hook, and trail rope. The last two are used in making a landing.

Some worth-while improvements have been made in better gas-tight materials for the bag and in the method of attaching basket cords and valve seats to the sphere. Economical means of producing pure helium have lately made this non-inflammable lifting gas available for general use. Helium does not give as much lift as hydrogen, but it is safer.

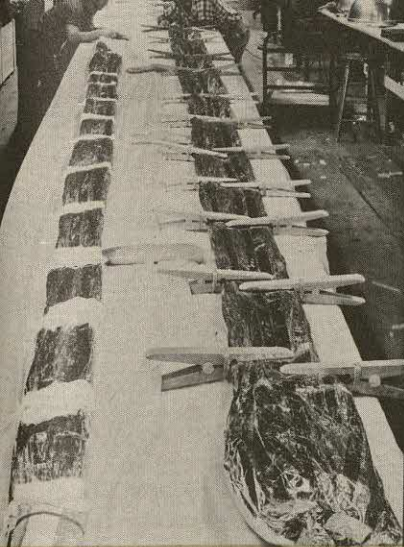
Free ballooning has many enthusiasts. Contestants in balloon races such as the annual Gordon Bennett Trophy event often travel more than 1,500 miles from their starting point.

Balloons were used as early as the French Revolution in attempts to observe and send dispatches. The Austrians in 1849 tried to attack Venice with incendiary fuses attached to balloons. *Captive balloons*, that is, balloons controlled from the ground, were used in the Civil War in America for observation and directing fire. In the Franco-Prussian War of 1870-71, tons of mail were sent and many people escaped from Paris past Prussian lines via balloons. Long sausage balloons, propelled by inflated tail fins, were used for observation in World War I. Observation balloons were not used in World War II. However, *barrage balloons*, that is, balloons suspending aerial mines, were used against enemy aircraft. Balloons have been used to carry propaganda behind the "iron curtain."

Balloons are sent up every day to gather data on the weather. Balloons are valuable for this purpose because they can be brought to a standstill and remain up for hours. The

proved, man was well started on the way to his conquest of the air.

Typical free balloons of the twentieth century do not differ a great deal in design from the earliest successful models, but are usually built much larger today, to give greater gas capacity and lift. Essentially, the free balloon is a large spherical bag of gas-tight material from which is suspended a basket or car for pilot, passengers, and gear. The bag is inflated with one of the lighter-than-air gases and is then capable of raising its load. Modern bags are frequently more than 100 feet in diameter.



DEFLATION

All the air is removed from a U.S. Echo balloon before it is packed into a metal globe for its trip to outer space.

NASA



INFLATION

Test inflated, Echo previews its reflecting ability as the world's first balloon satellite inflated in space August 12, 1960.

Bell Telephone System

small captive balloons determine the direction and speed of the wind. Free balloons, with radio transmitter and recording machines, called *radiosondes*, record data on temperature, humidity, and atmospheric pressure, and also radio it back to earth. The United States Office of Naval Research has been studying cosmic rays by balloon for years. Sharp photographs of the sun and the track of a helium nucleus have been taken from high altitudes. Naval scientists have ridden into a cumulus cloud to find data on generation of electricity and rain. Rocket-fired four-ounce weather balloons have reached 235,000 feet above the earth. High altitude balloons can be made to carry hundreds of pounds of instruments, such as thermo-nuclear devices for test explosions, and can provide a vibrationless platform for telescopes to observe the sun, moon, and other planets.

By means of *balloon gondolas*, new records for soaring into the air have been set. A gondola is a sealed airtight ball of light metal which supplies oxygen for human passengers at great heights. Records set since 1956 are: Naval Lieutenant Commanders Malcolm D. Ross and M. Lee Lewis ascended 76,000 feet in November, 1956, to

break the 1935 record of Army Captains Albert W. Stevens and Orvil A. Anderson. Air Force Captain Joseph W. Kittinger rose to 96,000 feet in June, 1957. Air Force Major David G. Simons rose to 102,000 feet in August, 1957, and remained above 90,000 feet for 26 hours. In August, 1960, Captain Kittinger set a new record of 102,800 feet. He rose in an open gondola but with a pressurized space suit. A record of 143,000 feet for an unmanned balloon ascension was set in 1956.

On August 12, 1960, the United States launched the plastic balloon Echo, 100 feet in diameter, as a satellite of the earth. Its orbit was 1,000 miles from the earth. Its aluminum coating was used to reflect radio messages and telephone conversations from one part of the United States to the other. Balloons have also been used to take rockets 100,000 feet into the atmosphere to start their space journeys.

Consult the following articles for further information:

Airplane
Atmosphere
Dirigible Balloon
Flying, Story of

Helium
Hydrogen
Satellite
Stratosphere

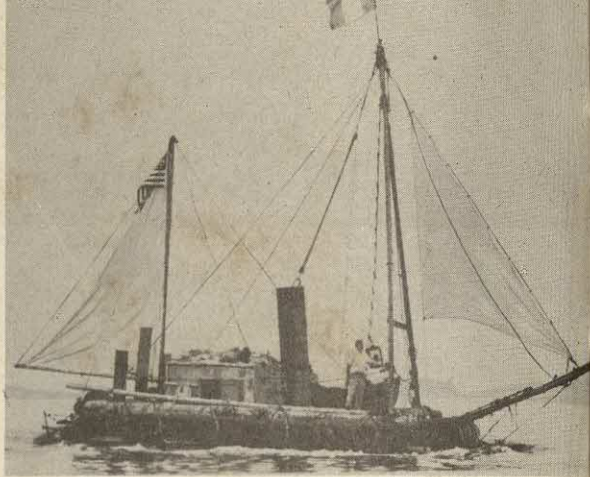
BAL'LOT. Secret voting is done by ballot. The name comes from a word which means *little ball*, from an old system of voting by colored balls. A black ball dropped in the ballot box was a "no" vote, a white ball a "yes" vote.

Secret voting dates back to the days of ancient Greece and Rome, when balls, stones, or shells were used in casting votes. Modern ballots are pieces of paper on which are written or printed the object of the vote. Today we consider the Australian ballot best, as it safeguards the public welfare in political matters requiring a vote by the people. This method of balloting requires the voter to mark his choice of candidates privately, in a booth. See ELECTION; VOTING MACHINE.

BALSA, *bawl'sah*. In the hot, tropical regions of South America, balsa trees grow rapidly and reach a height of about forty feet. The wood of these trees is the lightest ever found. It is only about one-half as heavy as cork and is very soft. Because the wood is so light and porous, it is often waterproofed and used for life preservers and life rafts on ships. It is also used in airplane construction and for insulating refrigerators and storage rooms.

BALSAM, *bawl'sam*. This is a sticky, resinous substance which flows from certain plants. Its pleasant, spicy odor is familiar to anyone who lives in a region where balsam trees grow. Balsams are found in the northern part of the United States, in Canada, in Peru, in Salvador, Central America, in Ceylon, and in some other countries. There are various types of balsam, either liquid or more or less solid. Balsams of commercial importance are the balm of Gilead, the balsam of copaiba, the balsam of Peru, and the balsam of Tolu. Balsams are used in making perfumes and such medicines as cough syrups and lozenges.

BALSAM FIR. Each year at Christmas time, evergreen trees laden with colored lights, tinsel, and presents make their appearance to lend cheer and gaiety to the holiday season. Many of these trees are



Associated Press

BALSA RAFT MAKES HISTORY

This balsa raft was used to show that a boat can ride ocean currents from Peru to Samoa.

stately, fragrant balsam firs, brought from the forests of Canada and Northeastern United States. The balsam is the popular New England Christmas tree, but it is by no means confined solely to that region. Many homes in other parts of the United States and Canada are decorated each December with this attractive fir.

Besides its use for Christmas decoration, the balsam fir is very important to medicine. The clear, pitchy substance obtained from the bark is used in preparing remedies, and for experiments in laboratories. Balsam leaves, packed in cloth bags and pillows, give temporary relief to hay fever and asthma sufferers. When spread thickly and evenly on the ground, balsam boughs are said to provide a comfortable and soft bed for campers. The balsam has little use in the lumber and paper industries, for its wood is weak and coarse and the fibers are very short.

The tree grows fairly tall and resembles a cone in shape. Its leaves are dark and are one-half to one and one-half inches long. The cones, colored a dark purple, stand erect on the branches near the top of the tree. The pitch used for medicinal purposes is secured from the white blisters which occur on the smooth bark. These blisters are tapped much like maple trees in obtaining sap for sugar, and the substance, called balsam, is refined and sold. See CONIFERS OR CONE BEARERS.



